

SOLICITATION, OFFER, AND AWARD <i>(Construction, Alteration, or Repair)</i>	1. SOLICITATION NO. DAKF10-01-B-0026	2. TYPE OF SOLICITATION <input checked="checked" type="checkbox"/> SEALED BID (IFB) <input type="checkbox"/> NEGOTIATED (RFP)	3. DATE ISSUED 13-Aug-2001	PAGE OF PAGES 1 OF 274
---	---	---	-------------------------------	---------------------------

IMPORTANT - The "offer" section on the reverse must be fully completed by offeror.

4. CONTRACT NO.	5. REQUISITION/PURCHASE REQUEST NO. W33Q9Y-1177-9891	6. PROJECT NO. E6 19-QJ
-----------------	---	----------------------------

7. ISSUED BY DIRECTORATE OF CONTRACTING HQS 3D ID (M) & FT STEWART SUITE 219 1042 WILLIAM H WILSON AVE FORT STEWART GA 31314-3300 TEL: FAX: 912-767-2969	CODE DAKF10	8. ADDRESS OFFER TO <i>(If Other Than Item 7)</i> See Item 7 TEL: FAX:
---	----------------	---

9. FOR INFORMATION CALL:	A. NAME WILLIE M BARNETT	B. TELEPHONE NO. <i>(Include area code) (NO COLLECT CALLS)</i> 912-767-2434
--------------------------	-----------------------------	--

SOLICITATION

NOTE: In sealed bid solicitations "offer" and "offeror" mean "bid" and "bidder".

10. THE GOVERNMENT REQUIRES PERFORMANCE OF THE WORK DESCRIBED IN THESE DOCUMENTS *(Title, identifying no., date):*
CONSTRUCT ENVIRONMENTAL BUILDING 615, HAAF, GA

1. Bidders who have questions pertaining to this solicitation should submit them in writing to the following e-mail address:
Willie.Barnett@stewart.army.mil

2. Bidders must fill in and return the SF1442, The Bid Price Schedule, and Section K.

3. Bidders must acknowledge receipt of all amendments to the solicitation - give number and date of each.

4. The Magnitude of this project is between \$250,000.00 and \$500,000.00.

5. This procurement is unrestricted.

6. Setion I, clause 52.211-12" Liquidated Damages--Construction" is \$101.00 for each day of delay.

7. See Section L, Clause 52.236-27 Alt I "Site Visit (Construction)" for time and date.

8. A Bid Bond form is on our Home Page for down loading at www.stewart.army.mil/DOC/intro.htm

11. The Contractor shall begin performance within <u>15</u> calendar days and complete it within <u>180</u> calendar days after receiving <input type="checkbox"/> award, <input checked="checked" type="checkbox"/> notice to proceed. This performance period is <input checked="checked" type="checkbox"/> mandatory, <input type="checkbox"/> negotiable. (See _____ .)
--

12 A. THE CONTRACTOR MUST FURNISH ANY REQUIRED PERFORMANCE AND PAYMENT BONDS? <i>(If "YES," indicate within how many calendar days after award in Item 12B.)</i> <input checked="checked" type="checkbox"/> YES <input type="checkbox"/> NO	12B. CALENDAR DAYS 10
---	--------------------------

13. ADDITIONAL SOLICITATION REQUIREMENTS:

A. Sealed offers in original and 0 copies to perform the work required are due at the place specified in Item 8 by 14:00:00 (hour) local time 9/18/2001 (date). If this is a sealed bid solicitation, offers must be publicly opened at that time. Sealed envelopes containing offers shall be marked to show the offeror's name and address, the solicitation number, and the date and time offers are due.

B. An offer guarantee ☒ is, ☐ is not required.

C. All offers are subject to the (1) work requirements, and (2) other provisions and clauses incorporated in the solicitation in full text or by reference.

D. Offers providing less than 90 calendar days for Government acceptance after the date offers are due will not be considered and will be rejected.

SOLICITATION, OFFER, AND AWARD (Continued) <i>(Construction, Alteration, or Repair)</i>												
OFFER (Must be fully completed by offeror)												
14. NAME AND ADDRESS OF OFFEROR <i>(Include ZIP Code)</i>					15. TELEPHONE NO. <i>(Include area code)</i>							
CODE FACILITY CODE					16. REMITTANCE ADDRESS <i>(Include only if different than Item 14)</i> See Item 14							
					17. The offeror agrees to perform the work required at the prices specified below in strict accordance with the terms of this solicitation, if this offer is accepted by the Government in writing within _____ calendar days after the date offers are due. <i>(Insert any number equal to or greater than the minimum requirements stated in Item 13D. Failure to insert any number means the offeror accepts the minimum in Item 13D.)</i>							
AMOUNTS SEE SCHEDULE OF PRICES					18. The offeror agrees to furnish any required performance and payment bonds.							
19. ACKNOWLEDGMENT OF AMENDMENTS <i>(The offeror acknowledges receipt of amendments to the solicitation -- give number and date of each)</i>												
AMENDMENT NO.												
DATE												
20A. NAME AND TITLE OF PERSON AUTHORIZED TO SIGN OFFER <i>(Type or print)</i>					20B. SIGNATURE				20C. OFFER DATE			
AWARD (To be completed by Government)												
21. ITEMS ACCEPTED: <div style="font-size: 24pt; font-weight: bold; margin-top: 10px;">SEE SCHEDULE</div>												
22. AMOUNT		23. ACCOUNTING AND APPROPRIATION DATA										
24. SUBMIT INVOICES TO ADDRESS SHOWN IN <i>(4 copies unless otherwise specified)</i>				ITEM	25. OTHER THAN FULL AND OPEN COMPETITION PURSUANT TO <input type="checkbox"/> 10 U.S.C. 2304(c) <input type="checkbox"/> 41 U.S.C. 253(c)							
26. ADMINISTERED BY			CODE		27. PAYMENT WILL BE MADE BY						CODE	
CONTRACTING OFFICER WILL COMPLETE ITEM 28 OR 29 AS APPLICABLE												
<input type="checkbox"/> 28. NEGOTIATED AGREEMENT <i>(Contractor is required to sign this document and return _____ copies to issuing office.)</i> Contractor agrees to furnish and deliver all items or perform all work, requisitions identified on this form and any continuation sheets for the consideration stated in this contract. The rights and obligations of the parties to this contract shall be governed by (a) this contract award, (b) the solicitation, and (c) the clauses, representations, certifications, and specifications or incorporated by reference in or attached to this contract.					<input type="checkbox"/> 29. AWARD <i>(Contractor is not required to sign this document.)</i> Your offer on this solicitation, is hereby accepted as to the items listed. This award consummates the contract, which consists of (a) the Government solicitation and your offer, and (b) this contract award. No further contractual document is necessary.							
30A. NAME AND TITLE OF CONTRACTOR OR PERSON AUTHORIZED TO SIGN <i>(Type or print)</i>					31A. NAME OF CONTRACTING OFFICER <i>(Type or print)</i>							
30B. SIGNATURE			30C. DATE			31B. UNITED STATES OF AMERICA BY			31C. AWARD DATE			

SECTION B Supplies or Services and Prices

ITEM NO	SUPPLIES/SERVICES	QUANTITY	UNIT	UNIT PRICE	AMOUNT
0001	CONSTRUCT ENVIRONMENTAL BLDG. 615, HAAF, GA FFP - FURNISH ALL PLANT, LABOR, MATERIAL, AND PERFORM ALL WORK REQUIRED IN CONNECTION WITH CONSTRUCT ENVIRONMENTAL BRANCH BUILDING 615, HAAF, GA. COMPLETE IN STRICT ACCORDANCE WITH SPECIFICATIONS AND DRAWINGS.	1.00	Lump Sum		
	PURCHASE REQUEST NUMBER W33Q9Y-1177-9891				

ITEM NO	SUPPLIES/SERVICES	QUANTITY	UNIT	UNIT PRICE	AMOUNT
0002	PROVIDE SODDING FFP	6,000.00	Square Foot		
	PURCHASE REQUEST NUMBER W33Q9Y-1177-9891				

ITEM NO	SUPPLIES/SERVICES	QUANTITY	UNIT	UNIT PRICE	AMOUNT
0003	PROVIDE EQUIPMENT FFP - REFRIGERATOR, MICROWAVE OVEN, RANGE HOOD	1.00	Lump Sum		
	PURCHASE REQUEST NUMBER W33Q9Y-1177-9891				

ITEM NO	SUPPLIES/SERVICES	QUANTITY	UNIT	UNIT PRICE	AMOUNT
0004	ADDITIVE ITEM FFP - PROVIDE ASPHALT PAVING (ADDITIOINAL AMOUNT INDICATED ON THE DRAWINGS)	300.00	Square Yard		
	PURCHASE REQUEST NUMBER W33Q9Y-1177-9891				

NOTES:

1. SUBJECT TO AVAILABILITY OF FUNDS: Funds are not presently available for this acquisition. No contract award will be made until appropriated funds are made available from which payment for contract purposes can be made.
2. See Section L, Provision DFARS 252.204-7004, entitled "Required Central Contractor Registration (CCR)". Prospective awardees must be registered in the CCR Database prior to award. Lack of registration in the CCR Database will make the bidder ineligible for award. Bidders are encouraged to register immediately at time of downloading the solicitation.

3. **STATUTORY COST LIMITATION:** A statutory cost limitation of \$500,000.00 applies to this project which includes any and all administrative government cost relating to these line items (see section I Clause 252.236-7006 “Cost Limitation”).

SECTION C Descriptions and Specifications**TECHNICAL PROVISIONS****GENERAL****1. DESCRIPTION OF WORK:**

1.1 Work to be Done: The work covered by this contract consists of furnishing all plant, labor, materials and performing all operations required in connection with Construct Environmental Branch Building, Hunter Army Airfield, Georgia, Building 615, complete in strict accordance with specifications and drawings, subject to the terms and conditions of the contract. The work includes, but is not necessarily restricted to, the following items.

1.1.1 Provide fill dirt, grading and excavate and backfill for buildings and utilities.

1.1.2 Provide and install concrete slabs for building and asphalt pavement for driveways.

1.1.3. Erect Metal Building System, (some components provided by the Government, some furnished by the contractor).

1.1.4 Provide and install brick veneer.

1.1.5 Provide and install overhead doors and framing.

1.1.6 Provide and install metal roof systems.

1.1.7 Provide and install metal doors/windows/frames.

1.1.8 Provide and install door hardware.

1.1.9 Provide and install resilient flooring.

1.1.10 Provide and install gypsum board walls and acoustic ceilings.

1.1.11 Provide and install paint systems for walls, doors and trim.

1.1.12 Provide and install toilet accessories.

1.1.13 Provide and install kitchen cabinets.

1.1.14 Provide and install plumbing fixtures and piping systems.

1.1.15 Provide and install HVAC systems and ductwork.

1.1.16 Provide and install electrical systems and lighting.

1.1.17 Provide and install kitchen equipment.

1.1.18 Provide and install metal lockers.

2. Government Furnished Materials

The Government shall provide a previously constructed metal building to the contractor for re-erecting on the site indicated. The components of the building that are available to be reused by the contractor are indicated on the drawings. Not all components are provided to erect the building as drawn. The contractor is responsible for determining which components are being provided by the Government for reuse and which components the contractor shall furnish to satisfy the contract drawings. Any components not furnished by the Government, the contractor shall provide. The building components that are to be provided by the Government for the contractor to construct the building are disassembled, packed and crated, and stored in the DPW yard, adjacent to building 1024, Hunter Army Airfield. It shall be the Contractor's responsibility to transport the components to the construction site from the DPW yard. The component parts become the contractor's responsibility once the material is removed from the DPW yard. A suitable location at the construction site shall be established and fenced by the contractor for the provided component parts. The contractor shall acquire and construct the security fence. The size, type and quality of the temporary security fence shall be the contractor's responsibility. Inventory and acceptance of the building components shall occur in the presence of the Contracting Officer's Representative (COR) and the Contractor's superintendent at the time of the component removal from the DPW yard. The inventoried list shall be signed and dated by the contractor's superintendent and the COR.

The government shall have available for the contractor a numbering/labeling system with all metal building components marked accordingly. Sketches shall be available with instructions corresponding to labeled salvaged components indicating sequence of disassembly/ re-assembly of components.

The contractor shall be responsible for re-assembly of the building using the contract drawings and the salvaged component list. Once the building is erected and has been accepted by the Government, the remaining component parts on site shall be removed from Government property by the contractor. The security fence and any remaining debris shall also be removed by the contractor and the site left clean. Government personnel POC for the salvaged component list is Jon Bairnsfather, General Engineer, Directorate of Public Works, Building 1021, Hunter Army Airfield, Georgia.

3. Scheduling

Contractor shall inform the COR in writing 15 days before work is to begin.

4. Contractor shall submit a safety plan to the COR prior to beginning work.

5. AS-BUILT RECORD DRAWINGS:

5.1 The Contractor shall be responsible for maintaining one set of master prints of the job site, on which he shall keep a neat and accurate record of all deviations from the original contract documents as the work progresses. The Contractor is responsible for noting all changes and corrections on these record drawing prints promptly as the changes occur, but in no case less often than on a weekly basis. The record prints which are maintained shall indicate all changes and modifications incorporated into the work as well as the following:

5.1.1 Actual locations of all subsurface and concealed utility lines, type of materials used, sizes, etc. shall be indicated. In order that the location of these lines and appurtenances may be determined in the event the surface openings or indicators become covered or obscured, the record drawings shall indicate by offset dimensions to two permanently fixed surface features the locations of the utilities. Valves, splice boxes and similar appurtenances shall be located by dimensions along the utility run from a reference point. The depth below the surface of each run shall be recorded along with any sharp deviations in depth or direction.

5.1.2 Any shop drawings which constitute part of the project shall be included with the record drawings.

5.2 The master/record prints with corrections noted, shall be certified as to their correctness by the signature of the Contractor, then submitted to the COR for approval. Once approved, the Government will provide an electronic file (Microstation) of the project to the Contractor. Point of Contact is Jerry Ennis, building 1114 at Fort Stewart, phone number (912) 767-5908. All Corrections noted on the master/record prints shall then be transferred to the electronic

file by the Contractor. The CAD electronic file (Microstation) with all corrected data shall be turned over to the COR for final approval and at this time the Contractor may receive final payment.

5.3 Existing Drawings

Drawings of the existing metal building to be provided by the Government and installed by the contractor under this contract are available for review at the Directorate of Public Works (DPW), Building 1021, Hunter Army Airfield. POC for this review is Jon Bairnsfather, 912-352-5807. No collect calls.

(END OF SECTION)

SECTION 02100**CLEARING AND GRUBBING****PART 1 - GENERAL****1. DEFINITIONS:**

1.1 Clearing: Clearing shall consist of the felling, trimming, and cutting of trees into sections and the satisfactory disposal of the trees and other vegetation designated for removal, including down timber, snags, brush, and rubbish occurring in the areas to be cleared.

1.2 Grubbing: Grubbing shall consist of the removal and disposal of stumps, roots larger than 3 inches in diameter, and matted roots from the designated grubbing areas.

PART 2 - EXECUTION

2. CLEARING: Trees, stumps, roots, brush, and other vegetation in areas to be cleared shall be removed completely and the hole backfilled, except such trees and vegetation as may be indicated or directed to be left standing. Trees designated to be left standing within the cleared areas shall be trimmed of dead branches 1-1/2 inches or more in diameter and shall be trimmed of all branches the heights indicated or directed. Limbs and branches to be trimmed shall be neatly cut close to the bole of the tree or main branches. Cuts more than 1-1/2 inches in diameter shall be painted with an approved tree-wound paint. Trees and vegetation to be left standing shall be protected from damage incident to clearing, grubbing, and construction operations by the erection of barriers or by such other means as the circumstances require.

3. GRUBBING: Material to be grubbed, together with logs and other organic or metallic debris not suitable for foundation purposes, shall be removed to a depth of not less than 18 inches below the original surface level of the ground in areas indicated to be grubbed and in areas indicated as construction areas under this contract, such as areas for buildings, and areas to be paved. Depressions made by grubbing shall be filled with suitable material and compacted to make the surface conform with the original adjacent surface of the ground.

4. TREE REMOVAL: Where indicated or directed trees and stumps that are designated as trees to be removed from areas outside those areas designated for clearing and grubbing. This work shall include the felling of such trees and the removal of their stumps and roots as specified in paragraph GRUBBING.

5. DISPOSAL OF MATERIALS:

5.1 Contractor shall be responsible for disposal of all material. Disposal of material shall in designated disposal sites on Government property.

(END OF SECTION)

SECTION 02201**EXCAVATION, FILLING AND BACKFILLING FOR BUILDINGS****PART 1 - GENERAL**

1. **APPLICABLE PUBLICATIONS:** The American Society for Testing and Materials (ASTM) publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

D 1556-82	Density of Soil in Place by the Sand-Cone Method
D 1557-78	Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.54 kg) Rammer and 8-in. (457-mm) Drop
D 2216-80	Laboratory Determination of Water(Moisture) Content of Soil, Rock, and oil-Aggregate Mixtures
D 2487-85	Classification of Soils For Engineering Purposes

2. **DEFINITIONS:**

2.1 **Satisfactory Materials:** Satisfactory materials include materials classified in ASTM D 2487 as GW, GP, SW, GM, GC, SP, and SM and shall be free of trash, debris, roots or other organic matter, or stones larger than 3 inches in any dimension.

2.2 **Unsatisfactory Materials:** Unsatisfactory materials include materials classified in ASTM D 2487 as PT, OH, OL, CH, ML, CL, ML and SC and any other materials not defined as satisfactory.

2.3 **Cohesionless and Cohesive Materials:** Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic.

2.4 **Degree of Compaction:** Degree of compaction required is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557, Method D, abbreviated hereinafter as percent laboratory maximum density.

PART 2 - PRODUCTS

3. **CAPILLARY WATER BARRIER** shall consist of clean sand used for mortar mixes.

PART 3 - EXECUTION

4. **CLEARING AND GRUBBING:** The areas within lines 5 feet outside of each building and structure line shall be cleared and grubbed of trees, stumps, roots, brush, and other vegetation, debris, existing foundations, pavements, utility lines, structures, fences, and other items that would interfere with construction operations. Stumps, logs, roots, and other organic matter shall be completely removed and the resulting depressions shall be filled with satisfactory material placed and compacted. Materials removed shall be disposed of outside the limits of Government- controlled property at the Contractor's responsibility.

5. **TOPSOIL:** Where directed topsoil shall be stripped to a depth of four(4) inches below existing grade within the designated excavations and grading lines and deposited in storage piles for later use. Excess topsoil shall be stockpiled in an area as directed by the COR, not to exceed 1 mile distance from job site.

6. EXCAVATION shall conform to the dimensions and elevations indicated for each building, structure, and footing except as specified herein-after, and shall include trenching for utility and foundation drainage systems to a point 5 feet beyond the building line of each building and structure, excavation for outside grease interceptors, underground fuel tanks, and all work incidental thereto. Excavation shall extend a sufficient distance from walls and footings to allow for placing and removal of forms. Excavations below indicated depths will not be permitted except to remove unsatisfactory material. Unsatisfactory material encountered below the grades shown shall be removed as directed and replaced with satisfactory material. Satisfactory material removed below the depths indicated without specific direction of the Contracting Officer shall be replaced at no additional cost to the Government to the indicated excavation grade with satisfactory materials, except that concrete footings shall be increased in thickness to the bottom of the overdepth excavations and over-break in rock excavation. Satisfactory material shall be placed and compacted as directed. Determination of elevations and measurements of approved overdepth excavation of unsatisfactory material below grades indicated shall be done under the direction of the COR.

7. DRAINAGE AND DEWATERING:

7.1 Drainage: Surface water shall be directed away from excavation and construction sites so as to prevent erosion and undermining of foundations. Diversion ditches, dikes and grading shall be provided and maintained as necessary during construction. Excavated slopes and backfill surfaces shall be protected to prevent erosion and sloughing. Excavation shall be performed so that the site and the area immediately surrounding the site and affecting operations at the site shall be continually and effectively drained.

7.2 Dewatering: Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. French drains, sumps, ditches or trenches will not be permitted within 3 feet of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the on site material.

8. BLASTING: Blasting will not be permitted.

9. UTILITY AND DRAIN TRENCHES: Trenches for underground utilities systems and drain lines shall be excavated to the required alignments and depths. The bottoms of trenches shall be graded to secure the required slope and shall be tamped if necessary to provide a firm pipe bed. Recesses shall be excavated to accommodate bells and joints so that pipe will be uniformly supported for the entire length. Rock, where encountered, shall be excavated to a depth of at least 6 inches below the bottom of the pipe, and the overdepth shall be backfilled with satisfactory material placed and compacted.

10. BORROW: Where satisfactory materials are not available in sufficient quantity from required excavations, approved materials shall be obtained at the Contractor's expense from off post..

11. EXCAVATED MATERIALS: Satisfactory excavated material required for fill or backfill shall be placed in the proper section of the permanent work required under this section or shall be separately stockpiled if it cannot be readily placed. Satisfactory material in excess of that required for the permanent work and all unsatisfactory material shall be disposed of and stockpiled as directed by the COR, not to exceed one(1) mile distance from job site.

12. FINAL GRADE OF SURFACES TO SUPPORT CONCRETE: Excavation to final grade shall not be made until just before concrete is to be placed.

13. SUBGRADE PREPARATION: Unsatisfactory material in surfaces to receive fill or in excavated areas shall be removed and replaced with satisfactory materials. The surface shall be scarified to a depth of 6 inches before the fill is started. Sloped surfaces steeper than 1 vertical to 4 horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. When subgrades are less than the specified density, the ground surface shall be broken up to a minimum depth of 6 inches, pulverized, and compacted to the specified density. When the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 12 inches and compacted as specified for the adjacent fill. Material shall not

be placed on surfaces that are muddy, frozen, or contain frost. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Material shall be moistened or aerated as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used.

14. SOIL TREATMENT: Just prior to placing concrete slab on grade and basement slab and just prior to backfilling around concrete or masonry foundations for structures, soil treatment shall be applied. Soil treatment agents shall be delivered to the jobsite in sealed and labeled containers bearing the manufacturer's warnings to be observed in the handling and use of soil treatment agents. Labels shall bear evidence of registration under the Federal Insecticide, Fungicide, and Rodenticide Act. Labeling information shall be submitted not less than 7 days in advance of the time the soil treatment agent is to be applied. Soil treatment agent shall be isofenphos, cypermethrin or permethrin in concentrations as recommended by the manufacturer. The maximum concentration for the chemical when used as a termiticide shall be used for soil treatment. Other soil treatment agents may be used with prior approval of the COR. Soil treatment agents shall be applied in accordance with the instructions on the label.

15. FILLING AND BACKFILLING: Satisfactory materials shall be used in bringing fills and backfills to the lines and grades indicated and for replacing unsatisfactory materials. Satisfactory materials shall be placed in horizontal layers not exceeding 8 inches in loose thickness, or 6 inches when hand- operated compactors are used. After placing, each layer shall be plowed, disked, or otherwise broken up, moistened or aerated as necessary, thoroughly mixed and compacted as specified. Backfilling shall not begin until construction below finish grade has been approved, underground utilities systems have been inspected, tested and approved, forms removed, and the excavation cleaned of trash and debris. Backfill shall be brought to indicated finish grade and shall include backfill for outside grease interceptors and underground fuel tanks. Backfill shall not be placed in wet or frozen areas. Where pipe is coated or wrapped for protection against corrosion, the backfill material up to an elevation 2 feet above sewer lines and 1 foot above other utility lines shall be free from stones larger than 1 inch in any dimension. Heavy equipment for spreading and compacting backfill shall not be operated closer to foundation or retaining walls than a distance equal to the height of backfill above the top of footing; the area remaining shall be compacted in layers not more than 4 inches in compacted thickness with power-driven hand tampers suitable for the material being compacted. Backfill shall be placed carefully around pipes or tanks to avoid damage to coatings, wrappings, or tanks. Backfill shall not be placed against foundation walls prior to 7 days after completion of the walls. As far as practicable, backfill shall be brought up evenly on each side of the wall and sloped to drain away from the wall. Each layer of fill and backfill shall be compacted to not less than the percentage of maximum density specified below:

<u>FILL, EMBANKMENT, and BACKFILL</u>	<u>Material</u>	<u>Maximum Density</u>	
		<u>Cohesive</u>	<u>Cohesionless</u>
Under structures, building slabs, steps, paved areas, around footings, and in trenches	90		95
Under sidewalks and grassed areas	85	90	
SUBGRADE			
Under building slabs, steps, and paved areas, top 12 inches	90	95	
Under sidewalks, top 6 inches	85	90	

Approved compacted subgrades that are disturbed by the Contractor's operations or adverse weather shall be scarified and compacted as specified herein before to the required density prior to further construction thereon. Recomaction over underground utilities and heating lines shall be by hand tamping.

16. TESTING: Testing shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government. Testing shall be performed by an approved commercial testing laboratory or may be performed by the Contractor subject to approval.

16.1 Field in-place density shall be determined in accordance with ASTM D 1556. Tests shall be performed in sufficient number to insure that the specified density is being obtained.

16.2 Moisture Contents: In the stockpile, excavation or borrow areas, a minimum of two tests per day per type of material or source of materials being placed during stable weather conditions. During unstable weather, tests shall be made as dictated by local conditions. Moisture contents shall be tested in accordance with ASTM D 2216.

17. CAPILLARY WATER BARRIER: Capillary Water Barrier under concrete floor and area-way slabs on grade shall be placed directly on the subgrade and shall be compacted with a minimum of two passes of a hand-operated plate-type vibratory compactor.

18. GRADING: Areas within 10 feet outside of each building and structure line shall be constructed true to grade, shaped to drain, and shall be maintained free of trash and debris until final inspection has been completed and the work has been accepted.

19. SPREADING TOPSOIL: Areas outside the building lines from which topsoil has been removed shall be topsoiled. The surface shall be free of materials that would hinder planting or maintenance operations. The subgrade shall be pulverized to a depth of 2 inches by disking or plowing for the bonding of topsoil with the subsoil. Topsoil shall then be uniformly spread, graded, and compacted to the thickness, elevations, slopes shown, and left free of surface irregularities. Topsoil shall be compacted by one pass of a cultipacker, roller, or other approved equipment weighing 100 to 160 pounds per linear foot of roller. Topsoil shall not be placed when the subgrade is frozen, excessively wet, extremely dry, or in a condition otherwise detrimental to seeding, planting, or proper grading.

20. PROTECTION: Settlement or washing that occurs in graded, topsoiled, or backfilled areas prior to acceptance of the work shall be repaired and grades re-established to the required elevations and slopes.

(END OF SECTION)

SECTION 02230**SELF LEVELING FLOWABLE
FILL MATERIAL****PART 1 GENERAL**

1. General: Flowable fill is a controlled low-strength material, which can be placed in self-leveling consistency or in a less flowable state to reduce the fluid pressures exerted by the material. The ultimate unconfined compressive strengths should be less than 200 PSI to maintain the ability to re-excavate, all voids will be filled with no honeycombs, and the hardened fill will not shrink.

1.1 Flowable fill is suitable for all routine backfilling and is especially beneficial as a structural backfill beneath foundations and as a backfill for abandoned pipelines, culverts, tanks and other below-grade structures, utility trenches, catch basins and drop inlets, vertical taps, bridge abutments, etc.

1.2 Flowable fill shall be placed from a ready-mix truck in a full depth layer without compaction of thin layers. Hardened flowable fill can serve as a temporary riding surface until a matching roadway can be placed on it.

PART 2 PRODUCT

2. MIX DESIGN: The mixes shall be designated in two categories, very flowable and less flowable which is controlled by the amount of water that is added. Contractor shall submit for approval the exact mix design, method of construction and equipment to be used.

MIX 1**LESS FLOWABLE**

Item	Weights	Volume
Cement	50 LBS	.25 CF
Fly Ash	600 LBS	4.24 CF
Sand	2500 LBS	15.17 CF
Water(55 GAL)	458 LBS	<u>7.34 CF</u>
TOTAL	27.00 CF	

MIX 2**VERY FLOWABLE**

Item	Weights	Volume
Cement	50 LBS	.25 CF
Fly Ash	600 LBS	4.24 CF
Sand	2500 LBS	15.17 CF
Water(65 GAL)	541 LBS	<u>8.68 CF</u>
TOTAL	28.34 CF	

The above values are based on the following specific gravity:

Cement	3.15
Fly Ash	2.27
Sand	2.64
Water	1.00

GRADATION OF SAND

SIZE	PERCENT BY WEIGHT
Passing No 4 Sieve	100
Passing No 16 Sieve	25-75
Passing No 100 Sieve	0-25

2.1 Unconfined compressive strength is approximately 80 PSI at 28 days and 150 PSI at 56 days.

2.2 LESS FLOWABLE MIX: Less flowable mix can be used when it is desirable to put traffic back on a roadway quickly, approximately 10 hours or when being used to backfill pipes which could float out of position due to the buoyant effect of the very flowable fill mix. The mix shall have the workability necessary to self consolidate around pipes without any honeycombing.

2.3 VERY FLOWABLE MIX: The very flowable fill mix is self leveling and should require minimal effort to place but requires a longer time to displace the extra water and develop load bearing capacity, approximately 20 hours.

2.4 ADDING WATER: Adding water to mix to obtain the desired plastic characteristics is allowed but only with the approval of the COR. If greater flowability is needed the mix design may be modified by adding in increments of 50 LBS of fly ash while decreasing in increments of 58 LBS of sand after approval by the COR.

2.5 INCREASE STRENGTH: To increase unconfined strength add in increments of 10 LBS of cement while decreasing in increments of 8 LBS of sand after approval of COR. This will decrease the ability of re-excavating the site in the future.

PART 3 EXECUTION

3. EXECUTION: The trench or excavation shall be prepared in accordance with appropriate specifications. All piping and underground utilities shall be done in accordance with appropriate specifications and manufacturer's recommendations. A minimum of 6 inches of flowable fill shall be above any utility line or as shown on the drawings.

3.1 The mix may be placed part or full depth as conditions dictate. When backfilling utility lines such as pipe culverts flowable fill shall be distributed evenly to prevent any movement of the line.

3.2 Vibrators shall not be used to consolidate the mix. The fill is self consolidating.

3.3 Finishing can be accomplished with a square shovel if the fill surface is at the bottom of the pavement or with a wood float if the surface will be temporarily used as a finish surface.

3.4 The flowable fill material shall be placed a minimum of 2 inches above required level to allow for some settling and shrinkage when pavement is to be installed. The fill material shall be shaved to required depth when hardened.

3.5 The flowable fill material does not need curing, but allowance for excess water runoff shall be made by crowning or sloping fill. Plastic sheets shall not be used on or around fill material.

(END OF SECTION)

SECTION 02316**EXCAVATION, TRENCHING, AND BACKFILLING
FOR UTILITIES SYSTEMS****PART 1 GENERAL**

1. **APPLICABLE PUBLICATIONS:** The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1.1 American Society of Testing and Materials (ASTM) Publications:

D 422-63	Particle-Size Analysis of Soils (R 1972)
D 1557-78	Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.54-kg) Rammer and 18-in. (457-mm) Drop
D 2487-85	Classification of Soils for Engineering Purposes

PART 2 PRODUCTS

2. **DEFINITIONS:**

2.1 **Satisfactory Materials:** Satisfactory materials shall consist of any material classified by ASTM D 2487 as SM, GM, GC, CL, CH, GW, GP, and SW.

2.2 **Unsatisfactory Materials:** Unsatisfactory materials shall be materials that do not comply with the requirements for satisfactory materials. Unsatisfactory materials include but are not limited to those materials containing roots and other organic matter, trash, debris, frozen materials and stones larger than 4 inches, and materials classified in ASTM D 2487, as MH, PT, OH, and OL. Unsatisfactory materials also include man-made fills, refuse, or backfills from previous construction.

2.3 **Cohesionless and Cohesive Materials:** Cohesionless materials shall include materials classified in ASTM D 2487 as GW, SP, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic.

2.4 **Unstable Material:** Unstable material shall consist of materials too wet to properly support the utility pipe, conduit, or appurtenant structure.

2.5 **Select Granular Material:** Select granular material shall consist of well-graded sand, gravel, crushed gravel, crushed stone or crushed slag composed of hard, tough and durable particles, and shall contain not more than 10 percent by weight of material passing a No. 200 mesh sieve and no less than 95 percent by weight passing the 1-inch sieve. The maximum allowable aggregate size shall be inches, or the maximum size recommended by the pipe manufacturer, whichever is smaller.

2.6 **Initial Backfill Material:** Initial backfill shall consist of select granular material or satisfactory materials free from rocks 3 inches or larger in any dimension or free from rocks of such size as recommended by the pipe manufacturer, whichever is smaller.

2.7 **Degree of Compaction:** Degree of compaction shall be expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557, Method D.

2.8 **Plastic Marking Tape:** Plastic marking tape shall be acid and alkali-resistant polyethylene film, 6 inches wide with a minimum thickness of 0.004 inch. Tape shall have a minimum strength of 1750 PSI lengthwise and 1500 PSI

crosswise. The tape shall be manufactured with integral wires to enable detection by a metal detector when tape is buried up to 3 feet deep. The tape shall be of a type specifically manufactured for marking and locating underground utilities. The metallic core of the tape shall be encased in a protective jacket or provided with other means to protect from corrosion. Tape color shall be as specified in table 1 and shall bear a continuous printed inscription describing the specific utility.

TABLE 1. Tape Color

Red:	Electric
Yellow:	Gas, Oil, Dangerous Materials
Orange:	Telephone, Telegraph, Television, Police and Fire Communications
Blue:	Water Systems
Green:	Sewer Systems

PART 3 EXECUTION

3. GENERAL QUALITY CONTROL TESTING shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government.

3.1 Testing Facilities: Tests shall be performed by an approved commercial testing laboratory or may be tested by facilities furnished by the Contractor. Cost incurred for any subsequent inspection required because of failure of the first inspection will be charged to the Contractor.

3.2 Testing of Backfill Materials: Characteristics of backfill materials shall be determined in accordance with particle size analysis of soils ASTM D 422 and moisture-density relations of soils ASTM 1557, Method D. A minimum of one particle size analysis and one moisture-density relation test shall be performed on each different type of material used for bedding and backfill.

3.3 SUBMITTALS: Copies of all laboratory and field test reports shall be submitted to the Contracting Officer within 24 hours of the completion of the test.

3.4 EXCAVATION: Excavation shall be performed to the lines and grades indicated. Rock excavation shall include removal and disposition of material defined as rock in paragraph DEFINITIONS. Earth excavation shall include removal and disposal of material not classified as rock excavation. During excavation, material satisfactory for backfilling shall be stockpiled in an orderly manner at a distance from the banks of the trench equal to the depth of the excavation, but in no instance closer than 2 feet. Grading shall be done as may be necessary to prevent surface water from flowing into the excavation, and any water accumulating therein shall be removed to maintain the stability of the bottom and sides of the excavation. Unauthorized over excavation shall be backfilled in accordance with paragraph BACKFILLING AND COMPACTION at no additional cost to the Government.

3.5 Trench Excavation: The trench shall be excavated as recommended by the manufacturer of the pipe to be installed. Trench walls below the top of the pipe shall be sloped, or made vertical, and of such width as recommended in the manufacturer's installation manual. Where no manufacturer's installation manual is available, trench walls shall be made vertical. Trench walls more than 5 feet high shall be shored, cut back to a stable slope, or provided with equivalent means of protection for employees who may be exposed to moving ground or cave-in. Trench walls which are cut back shall be excavated to at least the angle of repose of the soil. Special attention shall be given to slopes which may be adversely affected by weather or moisture content. The trench width below the top of pipe shall not exceed 24 inches plus pipe outside diameter (O.D.) for pipes of less than 24 inches inside diameter and shall not exceed 36 inches plus pipe outside diameter for sizes larger than 24 inches inside diameter.

3.5.1 Bottom Preparation: The bottoms of trenches shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing. Stones of 3 inches or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.

3.5.2 Removal of Unyielding Material: Where unyielding material is encountered in the bottom of the trench, such material shall be removed 12 inches below the required grade and replaced with suitable materials as provided in paragraph BACKFILLING AND COMPACTION.

3.5.3 Removal of Unstable Material: Where unstable material is encountered in the bottom of the trench, such material shall be removed to the depth directed and replaced to the proper grade with select granular material as provided in paragraph BACKFILLING AND COMPACTION. When removal of unstable material is required due to the fault or neglect of the contractor in his performance of the work, the resulting material shall be excavated and replaced by the Contractor without additional cost to the Government.

3.5.4 Excavation for Appurtenances: Excavation for manholes, catch basins, inlets, or similar structures shall be sufficient to leave at least 12 inches clear between the outer structure surfaces and the face of the excavation or support members. Removal of unstable material shall be as specified above. When concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

3.5.5 Stockpiles: Stockpiles of satisfactory material shall be placed and graded as directed. Stockpiles shall be kept in a neat and well drained condition, giving due consideration to drainage at all times. Stockpiles of satisfactory materials shall be protected from contamination which may destroy the quality and fitness of the stockpiled material.

3.6 BACKFILLING AND COMPACTION: Backfill material shall consist of satisfactory material, select granular material, or initial backfill material as required. Backfill shall be placed in layers not exceeding 6 inches loose thickness for compaction by hand operated machine compactors, and 8 inches loose thickness for other than hand operated machines, unless otherwise specified. Each layer shall be compacted to at least 95 percent maximum density for cohesionless soils and 90 percent maximum density for cohesive soils, unless otherwise specified.

3.6.1 Trench Backfill: Trenches shall be backfilled to the grade shown.

3.6.2 Replacement of Unstable Material: Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding 6 inches loose thickness.

3.6.3 Initial backfill material shall be placed and compacted with approved tampers to a height of at least one foot above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe.

3.6.4 Final Backfill: The remainder of the trench, except for special materials for roadways, railroads and airfields, shall be filled with satisfactory material.

3.6.5 Backfill for Appurtenances: After the manhole, catch basin, inlet, or similar structure has been constructed and the concrete has been allowed to cure for 3 days, backfill shall be placed in such a manner that the structure will not be damaged by the shock of falling earth. The backfill material shall be deposited and compacted as specified for final backfill, and shall be brought up evenly on all sides of the structure to prevent eccentric loading and excessive stress.

3.6.6 Backfill for Pavement Cuts: Backfill for utilities under pavement cuts shall be Self Leveling Flowable Fill Material as in section 02230.

3.7 Jacking, Boring and Tunneling: Where specified Contractor shall install utility lines by Jacking and Boring. This requirement will normally exist where utilities must cross railroads, highways, primary access roads and airfield pavements. The utility pipe shall be fully supported through sleeve pipe by spacers.

3.8 FIELD QUALITY CONTROL: Testing shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government.

3.8.1 Field Density Tests: Tests shall be performed in sufficient numbers to ensure that the specified density is being obtained. A minimum of one field density test per lift of backfill for every 300 feet of installation shall be performed. One moisture density relationship shall be determined for every 1500 cubic yards of material used. Field in-place density shall be determined in trenches. Improperly compacted trenches shall be reopened to the depth directed, then refilled and compacted to the density specified at no additional cost to the Government.

3.9 Plastic Marking Tape: Warning tape shall be installed directly above the pipe, at a depth of 18 to 24 inches below finish grade unless otherwise shown. The tape should be placed a minimum of 6 inches above gas lines.

3.10 Dewatering: Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the on site material.

(END OF SECTION)

SECTION 02554**BITUMINOUS PAVEMENTS
(Modified Georgia DOT Specification)**

1. GENERAL: The work specified herein comprises the construction of a bituminous pavement consisting of a graded-aggregate base course, bituminous prime-coat, bituminous tack-coat, and bituminous surface-course (central-plant, hot-mix). The construction of the bituminous pavement components shall conform to the requirements of the Department of Transportation, State of Georgia, Standard Specifications, Construction of Roads and Bridges, 1995 (GA DOT SPEC), except for the modifications or additions specified herein.

2. DESCRIPTION OF TERMS: Wherever, in the GA DOT SPEC, the following terms are used, the intent shall be understood as follows:

" State"	U.S. Government
" Department"	Contracting Officer(CO)
" Engineer"	Contracting Officer's Representative (COR)
" Proposal Form"	General Provisions, Special Conditions, or

Technical Specification

3. ESTABLISHMENT OF A JOB-MIX FORMULA: The bituminous plant- mix surface-course shall be applied in accordance with the GA DOT SPEC using asphaltic-concrete, type "F" mix(Section 828). A binder-course of type "B" mix shall be used. The job-mix formula, together with the test data, shall be furnished the COR for review and approval.

4. TRIAL OPERATION:

4.1 Trial operations of the bituminous plant will be required. However, this requirement may be waived by the COR if the Contractor obtains the bituminous mixture from a plant that is currently in operation and is producing a mixture meeting these specifications. The waiver will be based on the Contractor furnishing plant records verifying that the test requirements listed below are being met.

The following are tests to be performed on each batch:

- a. Computation of Theoretical Specific Gravity
- b. Mix Temperature
- c. One Extraction(Bitumen content/ Sieve Analysis)
- d. One set of Marshall Specimens(set of 3)

Perform the following tests on each Marshall Specimen:

- a. Stability
- b. Flow
- c. Unit Weight
- d. Percent Voids- Total Mix
- e. Percent Voids- Filled

4.1.2 Hot-Bin Proportioning: Before the "trial operation" begins, the Contractor will "charge" the separate hot bins at the mixing plant of each size aggregate through the rescreening plant in the manner the Contractor proposes to use during the paving operations. A sieve analysis will be made on each hot bin to determine proportions which will produce a combined gradation conforming to the job-mix formula. This process should be repeated a minimum of 3 times for each hot bin to check the consistency of the rescreening plant and the aggregates for conformance to the job-mix formula. Testing, labor and facilities shall be provided by the Contractor and the testing will be under the supervision of the COR.

4.1.3 Results of tests shall be compared to the job-mix formula for compliance. Necessary adjustments, corrections, etc., will be made at this time. The cost of the "Trial Operation", including labor, equipment, materials, and testing will be at the expense of the Contractor without any additional cost to the Government.

5. MATERIALS AND INSTALLATION:

5.1 Base (Section 310): Base for the paving operation shall be graded-aggregate base-course as shown on the plans. The construction of the base course shall adhere to the requirements of Section 310 (Graded-Aggregate Construction) of the GA DOT SPEC. Coarse aggregate shall be Class A, Group II in accordance with Section 800(Course Aggregate).

5.2 Bituminous Prime-Coat (Section 412): Prime-coat shall be applied in accordance with the requirements of Section 412 of the GA DOT SPEC. The prime-coat shall be Grade RC 30 or RC 70 (Section 821.01), applied at a rate of between 0.20 and 0.35 gallons per square yard. Emulsified-asphalt may be used upon approval of the COR.

5.3 Bituminous Tack-Coat (Section 413): If the prime-coat is not fresh, clean, and free from traffic marks, a bituminous tack-coat shall be applied immediately prior to application of the asphaltic-concrete surface-course. The tack-coat shall be applied in accordance with Section 413 of the GA DOT SPEC. The tack-coat shall be applied at a rate of between 0.08 and 0.15 gallons per square yard. Tack-coat shall be cationic emulsified asphalt, CRS-2h or CRS-3(Section 824.01) or asphalt cement, AC- 10, AC-15, AC-20 or AC-30(Section 820.01).

5.4 Bituminous Plant-Mix, Leveling-Course (Section 400): The leveling-course(if specified) shall be applied in accordance with Section 400 of the GA DOT SPEC using asphaltic-concrete, type "F" mix (Section 828.01). Mix designs shall be approved by the COR before being used in the work..

5.5 Bituminous Plant Mix Overlay Course(Section 400): The overlay course shall be applied in accordance with Section 400 of the GA DOT SPEC using asphaltic concrete type "F" mix (Section 828.01). Mix design shall be approved by the COR before being used in the work.

5.6 Bituminous Plant-Mix Surface-Course (Section 400): The surface-course shall be applied in accordance with Section 400 of the GA DOT SPEC using asphaltic-concrete, type "F" mix (Section 828.01). Mix designs shall be approved by the COR before being used in the work..

5.7 Bituminous Plant-Mix Binder-Course(Section 400): The binder course shall be applied in accordance with section 400 of the GA DOT SPEC using asphaltic-concrete, type "B" mix(Section 828). Mix designs shall be approved by the COR before being used in the work..

6. CONTROL TESTING: Listed below are the minimum number and types of field tests required for job control. The frequency of tests will be increased as ordered by the COR in the event proper control of the bituminous plant and placing operations are not being maintained with the minimum number of tests specified.

<u>Type of Test</u>	<u>Number of Tests</u>
Stability, flow, unit weight, percent voids, total mix, percent voids filled	Determine from a set of Marshall specimens prepared from each 200 tons of plant production or 4 hours of operation, which-ever is less frequent
In-place Density	One set (3 sawed samples) for each 200 tons of plant operation, whichever is less frequent(1/3 should be obtained at joints)
Extractions	1 per day

Sieve Analysis

1 per shipment

7. COPIES OF SPECIFICATIONS: During the performance of all work covered in this section, the Contractor shall keep at least one(1) copy of the referenced GA DOT SPEC on the job-site.

8. SPECIAL INSTALLATION INSTRUCTIONS: Bituminous pavers for placement of hot-mix asphaltic-concrete shall be equipped with fully automatic grade and slope controls. The grade control shall be based upon a sensing device or grid riding on a stringline, or from a ski riding on an adjacent lane. The ski used on a mobile referenced system shall have a minimum length of 30 feet. The equipment shall be adjusted as necessary to prevent or eliminate pulling or tearing.

9. WEIGHT BILLS: During paving operations, the Contractor shall furnish the COR a copy of all asphalt truck weight-bills. If the COR is at the site, weight-bills can be given to the COR before the COR leaves the site. If the COR is not present at the site, the Contractor shall turn the weight bills into the COR's office on the following working day.

10. TEMPORARY PAVEMENT MARKINGS: Temporary pavement markings shall be applied by the Contractor to newly paved roads (if paint striping is required as part of the contract) in accordance with Section 657, type TR of the GA DOT SPEC.

11. WEED CONTROL: This work consist of furnishing and applying a herbicide to eradicate or prevent growth of vegetation in accordance with Section 725 GA DOT SPEC.

(END OF SECTION)

SECTION 02578

**PAVEMENT MARKINGS
REFLECTIVE PAINT
(Modified 1995 Georgia DOT Specification)**

1. **APPLICABLE PUBLICATIONS:** The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1.1 Federal Specification (Fed Spec):

TT-B-1325B Beads (Glass Spheres): Retro-Reflective

TT-P-115E Paint, Traffic, Highway, White, and Yellow

1.2 Department of Transportation, State of Georgia, Standard Specifications for Construction of Roads and Bridges, 1995(GA DOT SPEC)

Section 652 Painting Traffic Stripe

2. **GENERAL:** The work specified herein comprises the construction of a reflectorized paint marking system. The installation of the traffic striping and markings shall conform to the requirements of the GA DOT SPEC, except for the modifications or additions specified herein.

3. **MATERIALS:** Paint and reflective media shall be in sealed containers that plainly shows the designated name, formula, or specification number, batch number, color, date of manufacture, manufacturer's name, formulation number, and directions, all of which shall be plainly legible at the time of use. The paint shall be homogeneous, easily stirred to smooth consistency, and shall show no hard settlement or other objectionable characteristics during a maximum storage period of 6 months.

3.1 **Paints:** Paints for roads, streets, and parking areas shall conform to Fed Spec TT-P-115, color as indicated on the drawings.

3.2 **Reflective Media:** Reflective media shall conform to Fed Spec TT-B-1325, Type I, gradation A.

4. **SAMPLING AND TESTING:** Materials proposed for use shall be stored on the project site in sealed and labeled containers, or segregated at the source of supply, sufficiently in advance of the needs. Upon notification by the Contractor that the material is at the site or source of supply, a quart sample of each batch of paint and reflective media shall be taken by random selection from sealed containers by the Contractor in the presence of a representative of the COR. Contents of the sampled containers shall be so thoroughly mixed as to render the sample truly representative. Samples shall be clearly identified by designated name, specification number, batch number, manufacturer's formulation number, project contract number, intended use and quantity involved. At the discretion of the COR, samples may be tested by the Government before approval, or material may be approved for use based on either of the following data furnished by the Contractor:

4.1 A test report showing that the proposed batch meets all the specified requirements.

4.2 A test report showing that a previous batch manufactured using the same formulation as that used in manufacturing the proposed batch met all specified requirements, and a report showing test results on the proposed batch for the following properties required in the material specifications: weight per gallon, viscosity, and drying time. If materials are approved based on reports furnished by the Contractor, samples will be retained by the Government for possible future testing should the material appear defective during or after application. When tested by the Government, if samples fail to meet specification requirements, the materials represented by the samples shall

be replaced and the cost of testing will be deducted from the payments due the Contractor at the rate of **\$400 per sample retested**.

5. EQUIPMENT: Equipment shall be as specified in GA DOT SPEC, Section 652.

6. SURFACE PREPARATION: New and old surfaces shall be prepared for painting in accordance with GA DOT SPEC, Section 652.

7. APPLICATION: Paint and reflective media shall be applied in accordance with GA DOT SPEC, Section 652.

8. PROTECTIVE MEASURES: The Contractor shall comply with the protective measures outlined in GA DOT SPEC, Section 652. Suitable warning signs shall be placed near the beginning of the worksites and well ahead of the worksites for alerting approaching traffic from both directions. Small markers shall be placed along newly painted lines to control traffic and prevent damage to newly painted surfaces. It is the Contractor's responsibility to protect privately owned property (i.e. automobiles) from damage by the Contractor's painting operation and equipment. Painting equipment shall be marked with large warning signs indicating slow-moving painting equipment is in operation.

9. TOLERANCE AND APPEARANCE: Tolerances and proper appearance shall be as outlined in GA DOT SPEC, Section 652.

10. CORRECTIVE MEASURES: Corrective measures required to be taken by the Contractor shall be as outlined in GA DOT SPEC, Section 652.

11. COPIES OF SPECIFICATIONS: During the performance of all work covered in this section, the Contractor shall keep at least one(1) copy of the referenced GA DOT SPEC on the job- site.

(END OF SECTION)

SECTION 02713**WATER LINES****PART 1 - GENERAL**

1. **APPLICABLE PUBLICATIONS:** The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1.1 American Water Works Association (AWWA) Standards:

B300-87	Hypochlorites
B301-87	Liquid Chlorine
C651-86	Disinfecting Water Mains
C900-89	Polyvinyl Chloride (PVC) Pressure Pipe 4 In. Through 12 In. for Water
M23-80	PVC Pipe -- Design and Installation

1. **GENERAL:** This section covers water distribution lines.

2.1 Piping for Water Distribution Lines shall be polyvinyl chloride (PVC) plastic.

3. **EXCAVATION, TRENCHING, AND BACKFILLING FOR WATER LINES:** Excavation, trenching, and backfilling shall be in accordance with the applicable provisions of SECTION 02316: EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS except as modified herein.

PART 2 - PRODUCTS

4. **MATERIALS** shall conform to the respective specifications and other requirements specified below:

4.1 Pipe:

4.1.1 Poly Vinyl Chloride (PVC) Plastic Pipe: All pipe, couplings and fittings shall be manufactured of material conforming to ASTM D 1784, Class 12454B.

4.1.1.1 Pipe 4-Inch Through 12-Inch Diameter: Pipe, couplings and fittings 4-inch through 12 inch diameter shall conform to the requirements of AWWA C900, Class 150, CIOD pipe dimensions only, elastomeric-gasket joint only, unless otherwise shown or specified.

4.2 Joints:

4.2.1 Poly Vinyl Chloride Pipe: Joints, fittings, and couplings shall be as specified for PVC pipe. Joints connecting pipe of differing materials shall be made in accordance with the manufacturer's recommendation as approved by the Contracting Officer.

4.3 Disinfection: Chlorinating materials shall conform to the following:

Chlorine, Liquid: AWWA B301.

Hypochlorite, Calcium and Sodium: AWWA B300.

PART 3 - EXECUTION

5. INSTALLATION:

5.1 Handling: Pipe and accessories shall be handled so as to insure delivery to the trench in sound, undamaged condition. Pipe shall be carried into position and not dragged. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. Poly vinyl chloride pipe and fittings shall be handled and stored in accordance with the manufacturer's recommendations.

5.2 Cutting of Pipe: Cutting of pipe shall be done in a neat and workmanlike manner without damage to the pipe. Unless otherwise recommended by the manufacturer and authorized by the Contracting Officer, cutting shall be done with an approved type mechanical cutter.

5.3 Placing and Laying: Pipe and accessories shall be carefully lowered into the trench by means of derrick, ropes, belt slings, or other authorized equipment. Under no circumstances shall any of the water-line materials be dropped or dumped into the trench. Care shall be taken to avoid abrasion of the pipe coating. Except where necessary in making connections with other lines or as authorized by the Contracting Officer, pipe shall be laid with the bells facing in the direction of laying. The full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bells, couplings, and joints. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid. Pipe shall not be laid in water or when trench conditions are unsuitable for the work. Water shall be kept out of the trench until joining is completed. When work is not in progress open ends of pipe shall be securely closed so that no trench water, earth, or other substance will enter the pipes or fittings. Where any part of the coating or lining is damaged, the repair shall be made by the Contractor at his expense in a satisfactory manner.

5.4 PVC shall be installed in accordance with AWWA M23.

6. TESTING: After the pipe is laid, the joints completed and the trench partially backfilled leaving the joints exposed for examination, the newly laid piping section shall be subjected for 1 hour to the existing water pressure. Cracked or defective pipe, joints, and fittings, discovered in consequence of this pressure test shall be removed and replaced with sound material, and the test shall be repeated until the test results are satisfactory.

7. DISINFECTION: Before acceptance of potable water operation, each unit of completed water line shall be disinfected as prescribed by as specified herein. After pressure tests have been made, the unit to be disinfected shall be thoroughly flushed with water until all entrained dirt and mud have been removed before introducing the chlorinating material. The chlorinating material shall be either liquid chlorine, calcium hypochlorite, or sodium hypochlorite, conforming to paragraph MATERIALS. The chlorinating material shall provide a dosage of not less than 50 ppm and shall be introduced into the water lines in an approved manner. Poly vinyl chloride(PVC) pipe lines shall be chlorinated using only the above specified chlorinating material in solution. In no case will the agent be introduced into the line in a dry solid state. The treated water shall be retained in the pipe long enough to destroy all non-spore-forming bacteria. Except where a shorter period is approved, the retention time shall be at least 24 hours and shall produce not less than 25 ppm of free chlorine residual throughout the line at the end of the retention period. All valves on the lines being disinfected shall be opened and closed several times during the contact period. The line shall then be flushed with clean water until the residual chlorine is reduced to less than 1.0 ppm.

8. CLEANUP: Upon completion of the installation of water lines, and appurtenances, all debris and surplus materials resulting from the work shall be removed.

(END OF SECTION)

SECTION 02935**TURF****PART 1 GENERAL****1.1 OMITTED**

1.2 REFERENCES: The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

FEDERAL SPECIFICATION (FS)

FS O-F-241 (Rev. D) Fertilizers, Mixed, Commercial

1.3 OMITTED**1.4 OMITTED****1.5 DELIVERY, STORAGE, AND HANDLING****1.5.1 Delivery**

1.5.1.1 Fertilizer and Lime: Delivery of fertilizer and lime to the site shall be in original, unopened containers bearing manufacturer's chemical analysis. Instead of containers, fertilizer and lime may be furnished in bulk. A chemical analysis shall be provided for bulk deliveries.

1.5.2 Storage: Seed, lime, and fertilizer shall be stored in cool, dry locations away from contaminants.

1.5.3 Handling: Except for bulk deliveries, materials shall not be dropped or dumped from vehicles.

PART 2 PRODUCTS**2.1 MATERIALS**

2.1.1 Seed: State-certified seed of the latest season's crop shall be provided in original sealed packages bearing the producer's guaranteed analysis for mixture percentage, purity, germination, weed seed content, and inert material. Labels shall be in conformance with USDA-01 and applicable state seed laws.

2.1.2. Spring/Summer Seed(Permanent Grass): Seed mixtures shall be proportioned by weight as follows:

Common Name	Mixture Percent By Weight	Percent Pure Live Seed
Bermuda	75	82

2.1.3. Fall/Winter Seed(Temporary Grass): Seed mixtures shall be proportioned by weight as follows:

Botanical Name	Common Name	Mixture Percent By Weight	Percent Pure Seed by Weight
Lolium Muldiflorum	Domestic Rye	75	88
Agrostis Alba	Red Top	25	83

2.1.4 Weed Seed: Weed seed shall not exceed 1 percent by weight of the total mixture. Wet, moldy, or otherwise damaged seed will be rejected.

2.1.5 Soil Amendments: Soil amendments shall consist of lime and fertilizer meeting the following requirements.

2.1.5.1 Lime: Commercial grade ground, hydrated or burnt limestone containing not less than 50 percent of total oxides, 85 percent calcium and magnesium oxides and ground to such fineness that a minimum 50 percent pass 100-mesh sieve and 98 percent pass 20-mesh sieve.

2.1.5.2 Fertilizer: Commercial grade, free flowing, uniform in composition and conforming to FS O-F-241.

a. Granular Fertilizer: Consists of nitrogen-phosphorus- potassium ratio: 10 to 15 percent nitrogen, 10 percent phosphorus, and 15 percent potassium.

2.1.6 Mulches: Mulches shall be free from weeds, mold, and other deleterious materials.

2.1.6.1 Straw: Straw shall be stalks from oats, wheat, rye, barley, or rice shall be furnished in air-dry condition and with a consistency for placing with commercial mulch blowing equipment.

2.1.6.2 Hay: Hay shall be native hay, sudan-grass hay, broomsedge hay, or other herbaceous mowings shall be furnished in an air-dry condition and with a consistency for placing with commercial mulch blowing equipment.

2.1.6.3 Wood Cellulose Fiber: Wood cellulose fiber shall not contain any growth or germination-inhibiting factors and shall be dyed an appropriate color to facilitate visual metering during application. Composition on air-dry weight basis: 9 to 15 percent moisture, pH range from 3.5 to 5.0. Use with hydro-seeding application of grass seed and fertilizer. When added to water, it forms a homogenous slurry.

2.1.7 Water: Water shall be of a quality suitable for irrigation.

PART 3 EXECUTION

3.1 SEEDING

3.1.1 Seeding Time: Seed shall be sown from 1 March to 15 August for spring/summer (Permanent Grass) planting and from 15 September to 15 November for fall/winter (Temporary Grass) planting.

3.2 SITE PREPARATION

3.2.1 Preparation of Seeding Areas

3.2.1.1 Grading: The COR shall verify the finished grades as indicated on drawings, and the placing of topsoil and the smooth grading has been completed.

3.2.1.2 Unsatisfactory Environmental Conditions: Site preparation work shall be performed only during periods when beneficial results can be obtained. When drought, excessive moisture or other unsatisfactory condition prevails, the work shall be stopped when directed by the COR.

3.2.2 Application of Lime and Fertilizer

3.2.2.1 Lime: Lime shall be applied at the rate of 2,000 pounds per acre. Lime shall be incorporated into the soil to a minimum depth of 4 inches or may be incorporated as part of the tillage operation.

3.2.2.2 Fertilizer: Fertilizer shall be applied at the rate of 1,200 pounds per acre. Fertilizer shall be incorporated into the soil to a minimum depth of 4 inches or may be incorporated as part of the tillage or hydro seeding operation.

3.2.2.3 Deviations: Deviations in the ground surface in relation to the grades indicated shall be corrected prior to turfing.

3.2.3 Tillage

3.2.3.1 Minimum Depth: Soil shall be tilled to a minimum depth of 4 inches by plowing, disking, harrowing, rototilling or other method. On slopes 2 horizontal to 1 vertical and steeper, the soil shall be tilled to a minimum depth of 2 inches by scarifying with heavy rakes, or other method. Roto-tillers shall be used where soil conditions and length of slope permit. On slopes 1 horizontal to 1 vertical and steeper, no tillage is required.

3.2.3.2 Applying Lime and Fertilizer: Lime and fertilizer, as specified, may be applied during tillage.

3.2.4 Finished Grading

3.2.4.1 Preparation: Turf areas shall be filled as needed or have surplus soil removed to attain the finished grade. Drainage patterns shall be maintained as indicated on drawings. Turf areas compacted by construction operations shall be completely pulverized by tillage. Soil used for repair of erosion or grade deficiencies shall conform to top soil requirements specified. Finished grade shall be 1 inch below the adjoining grade of any surfaced area. New surfaces shall be blended to existing areas.

3.2.4.2 Debris, 1 Inch: Lawn areas shall have debris and stones larger than 1 inch in any dimension removed from the surface.

3.2.4.3 Protection: Finished graded areas shall be protected from damage by vehicular or pedestrian traffic and erosion.

3.3 SEEDING

3.3.1 General: Prior to seeding, any previously prepared seedbed areas compacted or damaged by interim rains, traffic, or other cause, shall be reworked to restore the ground condition previously specified. Do not broadcast seed or hydroseed when the wind velocity is such as to prevent uniform seed distribution.

3.3.2 Applying Seed

3.3.2.1 Broadcast Seeding: Seed shall be uniformly broadcast at the rate of .4 pounds per 1000 square feet for spring/summer period (100 pounds per acre for fall/winter period) using broadcast seeders. Half of seed shall be broadcast in one direction, and the remainder at right angles to the first direction. Seed shall be covered to an average depth of 1/4 inch by disk harrow, steel mat drag, cultipacker, or other approved device.

3.3.2.2 Drill Seeding: Seed shall be uniformly drilled to an average depth of inch and at rates equal to that specified in the previous paragraph, using equipment having drills not more than 6-1/2 inches apart. Row markers shall be used with the drill seeder.

3.3.2.3 Rolling: Immediately after seeding, except for slopes 3 horizontal to 1 vertical and greater, the entire area shall be firmed with a roller not exceeding 90 pounds for each foot of roller width. Do not roll areas seeded with seed drills equipped with rollers.

3.3.3 Hydro seeding: Seed and fertilizer shall be added to water and thoroughly mixed at the rates specified. Wood cellulose fiber mulch shall be added at the rates recommended by the manufacturer after the seed, fertilizer and water have been thoroughly mixed to produce a homogenous slurry. Slurry shall be uniformly applied under pressure over the entire area. Adequate soil moisture shall be ensured by spraying water on the entire hydro seeded area and moisten the soil to a minimum depth of 2 inches. Do not roll the hydro seeded area.

3.3.4 Applying Mulch

3.3.4.1 Straw or Hay Mulch: On the same day as seeding, mulch shall be spread uniformly at the rate of 1-1/2 tons per acre. Mulch shall be spread by hand, blower-type mulch spreader or other approved method. Mulching shall be started on the windward side of relatively flat areas or on the upper part of slopes 2 horizontal and 1 vertical and steeper. Do not bunch the mulch.

3.3.4.2 Wood Cellulose Fiber: Wood cellulose fiber mulch shall be applied as part of the hydro seeding operation.

3.3.5 Water Seeded Areas: Watering shall be started within 7 days after completing the seeded area. Water shall be applied at the rate sufficient to ensure moist soil conditions to a minimum depth of 2 inches. Run-off and puddling shall be prevented.

3.4 OMITTED

3.5 OMITTED

3.6 EROSION CONTROL

3.6.1 Erosion Control Material: Where erosion control is indicated or required, install in accordance with manufacturer's instructions. Placement of the erosion control material shall be accomplished without damage to installed material or without deviation to finished grade.

3.7 RESTORATION AND CLEAN UP: Excess and waste material shall be removed and disposed of off the site. Adjacent paved areas shall be cleaned.

3.8 PROTECTION OF TURFED AREAS: Immediately after turfing, the area shall be protected from traffic or other use by erecting barricades.

3.9 TURF ESTABLISHMENT PERIOD

3.9.1 Length of Period: On completion of the last day of the turfing operation (installation of spring/summer grass), the Turf Establishment Period will be in effect, for at least 3 months, to be re-evaluated at 30, 60 and 90 days. If the stand of turf does not meet the requirements set forth in Stand of Turf the Contractor shall reseed as directed. This re-evaluation shall continue until the stand of turf is acceptable.

3.9.1.1 Site Inspections Contractor shall make a weekly site inspection during the Turf Establishment Period with the COR present and shall turn in a weekly report on the progress of the stand of turf until a satisfactory stand of turf is established.

3.9.2 Stand of Turf: A stand of turf from the seeding operation is defined as a minimum of 100 grass plants per square foot. Bare spots shall be no larger than 6 inches square and total bare spots shall not exceed 2 percent of the total seeded area.

3.9.3 Maintenance During Establishment Period: Maintenance of the turfed areas shall include irrigation, eradicating weeds, protecting embankments and ditches from erosion, maintaining erosion control material, and protecting turfed areas from traffic.

3.9.3.2 Repair: Turf condition shall be re-established as specified herein for eroded areas, damaged or barren areas. Mulch shall be repaired or replaced as required.

3.9.3.3 Mowing: Turfed areas shall be mowed to a minimum height of 1 inch when the average height of the turf becomes 1-1/2 inches. Clippings shall be removed when the amount of cut turf is heavy enough to damage the turfed areas.

3.9.3.4 Watering: Watering shall be at intervals to obtain a moist soil condition to a minimum depth of 2 inches. Frequency of watering and quantity of water shall be adjusted in accordance with the growth of the turf. Run-off, puddling and wilting shall be prevented.

3.9.3.5 Post-Fertilization: Nitrogen carrier fertilizer shall be applied at the rate of 30 pounds per acre after 30 days and again at 90 days.

3.10 FINAL ACCEPTANCE: At the end of the Turf Establishment Period, a final inspection will be made. Final acceptance of the turf will be based upon a satisfactory stand of turf as defined in the paragraph "TURF ESTABLISHMENT PERIOD." Rejected areas shall be replanted or repaired as directed by the COR.

(END OF SECTION)

SECTION 02936**TURF
(SODDING)****PART 1 GENERAL**

1.1. REFERENCES: The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

1.1.1. AMERICAN SOD PRODUCERS ASSOCIATION, INC. (ASPA)

ASPA-01 (Undated) Guideline Specifications to Sodding

1.1.3. FEDERAL SPECIFICATION (FS)

FS O-F-241 (Rev. D) Fertilizers, Mixed, Commercial

1.2 Omitted.

1.3 SUBMITTALS: The following shall be submitted in accordance with SPECIAL CLAUSES.

1.3.1. Certified copies of the reports for the following materials shall be submitted.

- a. Sod: For species, mixture percentage, percent purity and date of harvest.
- b. Fertilizer: For chemical analysis composition percent.
- c. Lime: For chemical analysis.

1.4 SOURCE INSPECTIONS: Sod and sprigging material will be subject to inspection by the Contracting Officer Representative (COR) at the growing site.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

1.5.1.1 Inspection: Turf material shall be inspected upon arrival at the jobsite, and unacceptable material shall be removed from the jobsite.

1.5.1.2 Protection: Sod shall be protected from drying out and from contamination during delivery.

1.5.1.3 Fertilizer and Lime: Delivery of fertilizer and lime to the site shall be in original, unopened containers bearing manufacturer's chemical analysis. Instead of containers, fertilizer and lime may be furnished in bulk. A chemical analysis shall be provided for bulk deliveries.

1.5.2 Storage: Materials shall be stored in areas designated by the Contracting Officer Representative (COR).

1.5.2.1 Sod shall be lightly sprinkled with water, covered with moist burlap, straw, or other covering; and protected from exposure to wind and direct sunlight until planted. Covering for sod shall allow air to circulate and prevent internal heat from building up.

1.5.2.2 Lime, and fertilizer shall be stored in cool, dry locations away from contaminants. Chemical treatment materials shall not be stored with other landscape materials.

1.5.3 Handling

1.5.3.1 Materials: Except for bulk deliveries, materials shall not be dropped or dumped from vehicles.

1.5.3.2 Time Limitation for Sod and Sprigs: Limitation of the time between harvesting and placing of sod and sprigs shall be as specified in paragraph "SODDING."

PART 2 PRODUCTS

2.1 MATERIALS

2.1.4 Soil Amendments: Soil amendments shall consist of lime, fertilizer and soil conditioners meeting the following requirements.

2.1.4.1 Lime: Commercial grade limestone containing not less than 50 percent of total oxides, 85 percent calcium and magnesium oxides and ground to such fineness that a minimum 50 percent pass 100-mesh sieve and 98 percent pass 20-mesh sieve.

2.1.4.2 Fertilizer: Commercial grade, free flowing, uniform in composition and conforming to FS O-F-241.

a. Granular Fertilizer: Consists of nitrogen-phosphorus- potassium ratio: 10 percent nitrogen, 10 percent phosphorus, and 10 percent potassium.

b. Controlled-Release Fertilizer: Consists of nitrogen- phosphorus-potassium ratio: 25 percent nitrogen, 10 percent phosphorous, and 10 percent potassium.

2.1.5 Straw: Straw shall be stalks from oats, wheat, rye, barley, or rice shall be furnished in air-dry condition and with a consistency for placing with commercial mulch blowing equipment.

2.1.6 Hay: Hay shall be native hay, sudan-grass hay, broomsedge hay, or other herbaceous mowings shall be furnished in an air-dry condition and with a consistency for placing with commercial mulch blowing equipment.

2.1.7 Water: Water shall be of a quality suitable for irrigation.

2.1.8 Erosion Control Material: Soil erosion control shall conform to the following:

2.1.9 Anchors: Erosion control anchor material shall be as recommended by the manufacturer.

2.1.10 Sod: The sod shall be bermuda.

PART 3 EXECUTION

3.1 SODDING TIMES

3.1.1 Sodding Time: Sod shall be sown from 15 March to 15 September without over seeding. After 15 September to 30 November the sod Shall be overseeded with a dwarf rye and anchored to assist root establishment and erosion control. Sod shall not be sown from 1 December to 15 March.

3.2 SITE PREPARATION

3.2.1 Preparation of Sodding Areas

3.2.1.1 Grading: The Contracting Officer shall verify the finished grades as indicated on drawings, and the placing of topsoil and the smooth grading has been completed.

3.2.1.2 Unsatisfactory Environmental Conditions: Site preparation work shall be performed only during periods when beneficial results can be obtained. When drought, excessive moisture or other unsatisfactory condition prevails, the work shall be stopped when directed.

3.2.2 Application of Soil Amendments

3.2.2.1 Lime: Lime shall be applied at the rate of 20 pounds per 1000 square feet. Lime shall be incorporated into the soil to a minimum depth of 4 inches or may be incorporated as part of the tillage operation.

3.2.2.3 Fertilizer: Fertilizer shall be applied at the rate of 25 pounds per 1000 square feet. Fertilizer shall be incorporated into the soil to a minimum depth of 4 inches.

3.2.2.5 Deviations: Deviations in the ground surface in relation to the grades indicated shall be corrected prior to turfing.

3.2.3 Tillage

3.2.3.1 Minimum Depth: Soil shall be tilled to a minimum depth of 4 inches by plowing, disking, harrowing, rototilling or other method. On slopes 2 horizontal to 1 vertical and steeper, the soil shall be tilled to a minimum depth of 2 inches by scarifying with heavy rakes, or other method. Rototillers shall be used where soil conditions and length of slope permit. On slopes 1 horizontal to 1 vertical and steeper, no tillage is required.

3.2.3.2 Applying Lime and Fertilizer: Lime and fertilizer, as specified, may be applied during tillage.

3.2.4 Finished Grading

3.2.4.1 Preparation: Turf areas shall be filled as needed or have surplus soil removed to attain the finished grade. Drainage patterns shall be maintained as indicated on drawings. Turf areas compacted by construction operations shall be completely pulverized by tillage. Finished grade shall be 1 inch below the adjoining grade of any surfaced area. New surfaces shall be blended to existing areas.

3.2.4.2 Debris: Lawn areas shall have debris and stones larger than 1 inch in any dimension removed from the surface.

3.2.4.4 Protection: Finished graded areas shall be protected from damage by vehicular or pedestrian traffic and erosion.

3.3. OMITTED

3.4 SODDING

3.4.1 General: Areas shall be sodded as indicated. Sod shall be placed in accordance with the ASPA-01 in the areas indicated. The time limitation between harvesting and placing sod is 36 hours. Sod that has become dry, moldy or yellow from heating will be rejected.

3.4.2 Placing Sod: Adequate soil moisture shall be ensured prior to sodding by spraying water on the area to be sodded and wetting the soil to a minimum depth of 2 inches. On long slopes sod shall be laid at right angles to slopes. In ditches sod shall be laid at right angles to the flow of water. When required, the sod shall be anchored by placing anchors a minimum distance of 2 feet on center with a minimum of 2 anchors per sod section.

3.4.3 Finishing: Air pockets shall be eliminated and a true and even surface shall be provided by tamping or rolling the sod in place. Displacement of the sod shall be assured by knitting of sod to the soil. Frayed edges shall be trimmed and holes or missing corners shall be patched in the sod.

3.4.4 Watering Sod: Watering shall be started immediately after completing each day of sodding. Water shall be applied at the rate sufficient to ensure moist soil conditions to a minimum depth of 2 inches. Run-off and puddling shall be prevented.

3.5 OMITTED

3.6 EROSION CONTROL

3.6.1 Erosion Control Material: Where erosion control is indicated or required, install in accordance with manufacturer's instructions. Placement of the erosion control material shall be accomplished without damage to installed material or without deviation to finished grade.

3.7 RESTORATION AND CLEAN UP: Excess and waste material shall be removed and disposed of off the site. Adjacent paved areas shall be cleaned. Existing turf areas which have been damaged during the contract operations shall be restored to original conditions.

3.8 PROTECTION OF TURFED AREAS: Immediately after turfing, the area shall be protected against traffic or other use by erecting barricades and providing signage as required or as directed by the Contracting Officer.

3.9 TURF ESTABLISHMENT PERIOD

3.9.1 Length of Period: On completion of the last day of the turfing operation, the Turf Establishment Period will be in effect for 3 months.

3.9.2 Stand of Turf

3.9.2.1 Sodding Operation: A stand of turf from the sodding operation is defined as living sod uniform in color and leaf texture. Bare spots shall be no larger than 6 inches square. The total bare spots shall not exceed 2 percent of the total sodded area.

3.9.3 Maintenance During Establishment Period

3.9.3.1 General: Maintenance of the turfed areas shall include eradicating weeds, protecting embankments and ditches from erosion, maintaining erosion control material, and protecting turfed areas from traffic.

3.9.3.2 Repair: Turf condition shall be reestablished as specified herein for eroded areas, damaged or barren areas.

3.9.3.3 Mowing: Turfed areas shall be mowed to a minimum height of 2 inches when the average height of the turf becomes 4 inches. Clippings shall be removed when the amount of cut turf is heavy enough to damage the turfed areas.

3.9.3.4 Watering: Watering shall be at intervals to obtain a moist soil condition to a minimum depth of 2 inches. Frequency of watering and quantity of water shall be adjusted in accordance with the growth of the turf. Run-off, puddling and wilting shall be prevented.

3.9.3.5 Post-Fertilization: Fertilizer shall be applied at the rate of 20 pounds per 1000 square feet after the first month. The application shall be timed prior to the advent of winter dormancy and shall avoid excessive high nitrogen levels.

3.10 FINAL ACCEPTANCE: At the end of the Turf Establishment Period, a final inspection will be made. Final acceptance of the turf will be based upon a satisfactory stand of turf as defined in the paragraph "TURF ESTABLISHMENT PERIOD." Rejected areas shall be replanted or repaired as directed by the Contracting Officer.

(END OF SECTION)

SECTION 03300**CAST-IN-PLACE CONCRETE****PART 1 GENERAL**

1.1 REFERENCES: The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 301 (1994) Structural Concrete for Buildings

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 497 (1994; Rev. A) Steel Welded Wire Fabric, Deformed, for Concrete
Reinforcement

ASTM A 615/ (1994) Deformed and Plain Billet-Steel Bars for Concrete

A 615M Reinforcement

ASTM C 94 (1994) Ready-Mixed Concrete

ASTM C 260 (1994) Air-Entraining Admixtures for Concrete

ASTM C 309 (1993) Liquid Membrane-Forming Compounds for Curing Concrete

ASTM C 330 (1989) Lightweight Aggregate for Structural Concrete

ASTM C 567 (1991) Unit Weight of Structural Lightweight Concrete

ASTM C 1107 (1991; Rev. A) Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

1.2 SUBMITTALS: Submit the following:

1.2.1 Instructions and Certificate

a. Liquid Membrane-Forming Compounds

1.2.2 Test Data

a. Concrete Strength. One set of 2 test cylinders to determine 28 days compressive strength shall be made. A minimum of one test per day for each day concrete is placed and for each 50 cubic yards placed is required.

1.3 DELIVERY: Do not deliver concrete until forms, reinforcement and embedded items are in place and ready for concrete placement.

PART 2 PRODUCTS

2.1 READY-MIXED CONCRETE: ASTM C 94, Concrete shall have a 28-day compressive strength of 20 MPA, 3000, psi. Compressive strength must be reached in 7 days when high-early-strength cement is used. Slump shall be between 50 and 100 mm, 2 and 4 inches. Provide aggregate Size No. 67, ASTM C 260, 5 to 7 percent air entrainment by volume of concrete.

2.2 REINFORCEMENT

2.2.1 Reinforcing Bars: ASTM A 615/A 615M, Grade 40 or 60.

2.2.2 Welded Wire Fabric: ASTM A 497.

2.3 MATERIALS FOR CURING CONCRETE

2.3.1 Impervious Sheeting: Waterproof paper, clear or white polyethylene sheeting, or polyethylene-coated burlap.

2.3.2 Liquid Membrane-Forming Compounds: ASTM C 309, white-pigmented, Type 2, free of paraffin or petroleum.

2.4 MOISTURE BARRIER: Polyethylene sheeting, minimum 0.15 mm, (6 mil), thickness, vapor barrier, permeance rating not exceeding 0.5 perms.

2.5 NONSHRINK GROUT: ASTM C 1107.

2.6 FORM MATERIALS: Provide metal, plywood, or hardboard forms capable of producing the required surface without adverse effect on concrete. Do not use form coating that adversely affects concrete surfaces or impairs subsequent applications to the concrete. Provide metal form ties, factory-fabricated, removable or snap-off type that will leave holes less than 6 mm, 1/4 inch, deep and not more than 25 mm, one inch, in diameter.

2.7 NONSLIP SURFACING MATERIAL: Provide nonslip surfacing material consisting of 55 percent, minimum, aluminum oxide or silicon-dioxide abrasive ceramically bonded to form a homogenous material sufficiently porous to give good bond with portland paste; or factory-graded emery material consisting of not less than 45 percent aluminum oxide and 25 percent ferric oxide. Provide well graded material, from particles retained on the No. 30 sieve to particles passing the No. 8 sieve.

2.8 FLOOR HARDENER: (Where Required) Floor hardener shall be a colorless aqueous solution containing zinc silicofluoride, magnesium silicofluoride or sodium silicofluoride. These silicofluorides can be used individually or in combination.

2.9 LIGHTWEIGHT AGGREGATE STRUCTURAL CONCRETE: Lightweight aggregate structural concrete shall conform to the requirements specified for normal weight concrete except as specified herein. Lightweight aggregate structural concrete shall have a 28 day compressive strength of at least 2500 psi (17.3Mpa). Air dry unit weight not exceeding 115 pcf (1850 kg/cubic meter) as determined by ASTM C 567.

2.9.1 Lightweight Aggregate: Lightweight fine and coarse aggregate shall conform to the quality and gradation requirements of ASTM C 330.

PART 3 EXECUTION

3.1 FORMS: ACI 301.

3.2 PLACING REINFORCEMENT: ACI 301. Provide bars, wire fabric, including wire ties, supports, and other devices necessary to install and secure the reinforcement.

3.3 SETTING MISCELLANEOUS MATERIAL: Place and secure anchors and bolts, pipe sleeves, conduits, and other such items in position before concrete placement. Plumb anchor bolts and check location and elevation. Temporarily fill voids in sleeves with readily removable material to prevent the entry of concrete.

3.4 INSTALLATION OF MOISTURE BARRIER: Provide beneath the on-grade concrete floor slab. Lap 100 mm, 4 inches, minimum, and seal laps and patches with pressure-sensitive adhesive or tape 500 mm, 2 inches, wide, minimum.

3.5 CONCRETE PLACEMENT: Deliver concrete from mixer to forms continuously until approved unit of operation is completed. Provide scaffolding, ramps and walkways so that personnel and equipment are not supported by in-place reinforcement. Placing will not be permitted when sun, heat, wind, or limitations of facilities furnished by the Contractor prevent proper consolidation, finishing and curing. Deposit concrete as close as possible to its final position in the forms. When a vertical drop greater than 2400 mm, 8 feet, is authorized, provide equipment to prevent segregation. Regulate depositing of concrete so that it will be consolidated in horizontal layers not more than 300 mm, 12 inches, thick. Place slabs in one layer. Screed concrete to provide levels and profiles indicated.

3.6 CONSOLIDATION: Immediately after placing, consolidate each layer of concrete by internal vibrators, except for slabs 100 mm, 4 inches, or less. Use vibrators adequate in effectiveness and number to properly consolidate the concrete; keep a spare vibrator at the job site during placing operations.

3.7 WEATHER LIMITATIONS: Use special protection measures as approved by Contracting Officer, when freezing temperatures are anticipated before expiration of the specified curing period. Temperature of concrete placed during warm weather shall not exceed 29 degrees C, 85 degrees F, except where an approved retarder is used.

3.8 CONSTRUCTION JOINTS: Locate where indicated or approved. Where concrete work is interrupted by weather, end of work shift or other type of delay, location and type of construction joint shall be subject to approval of the Contracting Officer.

3.9 SURFACE FINISHES: ACI 301 for repair and finish. Slope floors uniformly to drains where drains are provided.

3.9.1 Floated Finish: Place, consolidate, and immediately strike off concrete to obtain proper contour, grade, and elevation before bleed water appears. Permit concrete to attain a set sufficient for floating and supporting the weight of the finisher and equipment. When bleed water is present prior to floating the surface, drag excess water off or remove by absorption with porous materials. Do not use dry cement to absorb bleed water. Surface shall be level to within 6 mm in 3000 mm, 1/4 inch in 10 feet, where floor drains are not provided.

3.9.2 Broomed Finish: Provide for exterior walks, platforms, patios, and ramps, unless otherwise indicated. Provide a floated finish, then finish with a flexible bristle broom. Permit surface to harden sufficiently to retain the scoring or ridges. Broom transverse to traffic or at right angles to the slope of the slab.

3.9.3 Pavement Finish: Screed the concrete with a template advanced with a combined longitudinal and crosswise motion. Maintain a slight surplus of concrete ahead of the template. After screeding, float the concrete longitudinally. Use a straight edge to check slope and flatness; correct and refloat as necessary. Obtain final finish by dragging a strip of clean, wet burlap from 900 to 3000 mm, 3 to 10 feet wide and 600 mm, 2 feet longer than the pavement width across the slab. Produce a fine, granular, or sandy textured surface without disfiguring marks. Round edges and joints with an edger having a radius of 3 mm, 1/8 inch.

3.10 CURING AND PROTECTION: ACI 301. Preserve moisture, protect from temperature extremes, wind and rain, and from mechanical injury. Areas to receive floor hardener shall be wet cured only.

3.11 SETTING BASE PLATES AND BEARING PLATES: Clean and dampen concrete surface before grouting. Set plate or equipment base to line and elevation. Provide grout at least 20 mm, 3/4 inches, thick. Surfaces in contact with grout shall be free of oil and grease.

3.12 FLOOR HARDENER(Where Required): Floor hardener shall be applied after the concrete has been cured and then air dried for 14 days. Three coats shall be applied, each 24 hours after the preceding coat was applied. The first application shall be at the rate of .5 kg(one pound) of silicofluoride shall be dissolved in 4 liters(one gallon) of water. The subsequent applications at the rate of 1.0 kg(two pounds) of silicofluoride to each 4 liters(one gallon)

of water. Floor should be mopped with clear water shortly after preceding application has dried to removed encrusted salts.

(END OF SECTION)

SECTION 04200**MASONRY****PART 1 GENERAL****1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 82	(1988) Steel Wire, Plain, for Concrete Reinforcement
ASTM A 153	(1982; R 1987) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM C 62	(1995) Building Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 91	(1989) Masonry Cement
ASTM C 270	(1988) Mortar for Unit Masonry
ASTM C 476	(1983) Grout for Masonry
ASTM C 494	(1986) Chemical Admixtures for Concrete
ASTM C 780	(1987) Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry

1.2 SUBMITTALS**Samples**

Brick samples for brick color #1 and color #2

1.3 DELIVERY, HANDLING, AND STORAGE

Materials shall be delivered, handled, and stored in a manner to avoid chipping, breakage, and contact with soil or contaminating material. Units shall be stored off the ground and protected from inclement weather. Anchors, ties, and joint reinforcement shall be stored in a dry location. Cementitious materials shall be delivered in unopened containers plainly marked and labeled with manufacturers' names and brands. Cementitious materials shall be stored in dry, weathertight enclosures or covers. Sand shall be stored in a manner to prevent contamination.

PART 2 PRODUCTS**2.1 CLAY OR SHALE BRICK**

Clay or shale brick shall conform to ASTM C 62, selected for color range indicated by the approved sample. Brick shall be modular in size required to complete the work indicated. Grade SW shall be used for the first six courses above grade. Grade SW or MW shall be used in other brick work.

2.2 MORTAR

Mortar shall conform to ASTM C 270, Type M, except as otherwise specified. Mortar mix shall be based on

laboratory-proportioned and tested mix. Laboratory testing of mortar shall be in accordance with the preconstruction evaluation of mortar section of ASTM C 780. Mortar mix shall be such that the mortar will develop a minimum laboratory compressive strength of 2500 psi at 28 days. Laboratory proportioned mortar shall be mixed to an initial flow of 100 to 115 percent and shall retain a flow after suction of at least 70 percent when tested for water retention in accordance with ASTM C 91. Cement shall be of one brand. Aggregates shall be from one source. Accelerating admixture, if used, shall be noncorrosive and chloride free conforming to ASTM C 494, Type C.

2.3 GROUT

Grout unless otherwise specified, shall conform to the requirements of ASTM C 476. Grout shall be laboratory-proportioned for a 2500 psi mix when tested in accordance with paragraph "STRENGTH TESTS OF GROUT." Grout slump shall be between 9 and 11 inches. Except as otherwise specified, fine grout shall be used to fill spaces where the smallest dimension is 2 inches or less. Coarse grout shall be used to fill spaces where the smallest dimension is greater than 2 inches.

2.4 JOINT REINFORCEMENT

Joint reinforcement shall be fabricated of steel wire conforming to ASTM A 82. Fabrication shall be by welding; tack welding will not be permitted. Reinforcement shall be zinc-coated after fabrication in accordance with ASTM A 153, Class B-2. Reinforcement shall consist of 3 or more longitudinal wires joined with lateral wires in a truss-type system. Spacing of lateral wires along the longitudinal wires shall not exceed 16 inches. Wire thickness of lateral wire shall not be less than 9 gauge and thickness of longitudinal wires shall not be less than 9 gauge. Drips or crimps shall not be formed in lateral wires. The outermost longitudinal wires shall be spaced 2 inches, plus or minus 1/8 inch, less than the nominal wall width in which placed. Joint reinforcement for cavity walls may be furnished with rectangular wall-type ties extending to the longitudinal wires. Reinforcement for straight runs shall be furnished in flat sections not less than 10 feet long. Factory-formed pieces shall be provided for corners and intersections of walls and partitions. If approved for use, joint reinforcement may be furnished with adjustable wall tie feature. Such assemblies shall consist of double eye or ladder section welded to joint reinforcement at 24 inches on center. Adjustable portion of the assembly shall consist of a U-shape double pintle tie or hook type box tie fabricated of 3/16-inch steel wire. Pintle or hook portion of ties shall allow a maximum of 1-1/2 inch eccentricity between the elements of adjustable assemblies. Clearance between pintle and eye opening shall not exceed 1/16 inch. Assemblies shall be of the design to match the type of wall construction.

2.5 VENEER ANCHORS

Veneer anchors for attaching masonry to light metal framing shall be rectangular or triangular in shape and shall be fabricated of 3/16-inch steel wire with provisions for attaching to framing. Anchors shall have a minimum vertical adjustment of 2 inches. Stud plates shall have a minimum of two holes for attachment hardware. Anchors shall be of a length to extend from framing to within 1/2 to 3/4 inch of the exposed surface of the masonry wall. Veneer anchors shall have a clip for the attachment of a single horizontal wire imbedded in the mortar joint of brick veneer walls. The clip shall be an extrusion of impact-resistant, rigid PVC.

2.6 FLASHING

Aluminum flashing shall be provided as indicated on the drawings and as required for proper waterproofing.

2.7 EXPANSION JOINT MATERIALS

Backer rod and sealant shall be adequate to accommodate joint compression equal to 50 percent of the width of the joint. The backer rod shall be compressible rod stock of polyethylene foam, polyurethane foam, butyl rubber foam, or other flexible, nonabsorptive material as recommended by the sealant manufacturer. Sealant shall conform to Section 07920 JOINT SEALING.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

Wall sections, types of construction, and dimensions shall be as shown. Masonry shall be laid in running bond and vertical joints shall be kept plumb. Units being laid and surfaces to receive units shall be free of water film and frost. Units shall be laid in a nonfurrowed full bed of mortar, beveled and sloped toward the center of the wythe on which the mortar was placed. Units shall be shoved into place so that the vertical joints are tight. Vertical joints of brick and the vertical face shells of concrete masonry units, except where indicated at control and expansion joints, shall be completely filled with mortar. Units that have been disturbed after the mortar has stiffened shall be removed, cleaned and relaid with fresh mortar. Fins will be permitted to protrude up to 1/2 inch into the space between the facing wythe and the backup wall; means shall be provided to prevent mortar from dropping into the space below. Chases and raked-out joints shall be kept free from mortar and other debris. Space around metal door frames and other built-in items shall be solidly filled with mortar as each course is laid. Faces of units in finished areas shall be free from chipped edges or other imperfections detracting from the appearance of the finish work. Weep holes in cavity walls shall be provided over foundations, through-wall flashing and any other interruptions of the cavity.

3.1.1 Surface Preparation

Surfaces on which masonry is to be laid shall be cleaned of laitance and other foreign material and slightly roughened to provide a surface texture with a depth of at least 1/8 inch.

3.1.2 Hot Weather Masonry Construction

Masonry erected when the ambient air has a temperature of more than 99 degrees F in the shade and has a relative humidity of less than 50 percent shall be protected from direct exposure to wind and sun during installation and for 48 hours after installation.

3.1.3 Cold Weather Masonry Construction

Temperatures of masonry units shall not be less than 40 degrees F when laid and the temperature of the mortar and grout used shall be between 40 degrees F and 120 degrees F. When the ambient temperature is 32 degrees F or less, masonry work under construction shall be protected and maintained at a temperature greater than 32 degrees F during installation and for a period of 24 hours after installation. The proposed method of maintaining the temperature within the specified range shall be submitted for approval prior to implementation.

3.1.4 Tolerances

Except for work constructed of ceramic glazed structural clay facing units or prefaced concrete masonry units, masonry units shall be laid plumb, level and true to line units within the tolerances specified in TABLE 2; and all corners shall be square unless otherwise indicated.

TABLE 2

Variation from plumb	
In adjacent units	1/8 inch
In 10 feet	1/4 inch
In 20 feet	3/8 inch
In 40 feet or more	1/2 inch

Variation from level or grades

In 10 feet	1/8 inch
In 20 feet	1/4 inch
In 40 feet or more	1/2 inch

Variation from linear building lines

In 20 feet	3/8 inch
In 40 feet or more	1/2 inch

Variation from cross sectional dimensions
of columns and walls

Plus 1/2 inch to minus 1/4 inch

3.2 MIXING OF MORTAR

Mortar shall be mixed in a mechanically operated mortar mixer for at least 3 minutes but not more than 5 minutes. Measurement of ingredients for mortar shall be either by volume or weight. If ingredients are measured by volume, measurement of sand shall be accomplished by the use of a container of known capacity or shovel count based on a container of known capacity. If ingredients are measured by weight, measurement of sand shall be based on the dry weight of sand of 80 pounds per cubic foot. Water shall be mixed with the dry ingredients in sufficient amount to provide a workable mixture which will adhere to the vertical surfaces of masonry units. Mortar that has stiffened because of loss of water through evaporation shall be retempered by adding water to restore the proper consistency and workability; mortar that has reached its initial set or that has not been used within 2-1/2 hours shall be discarded.

3.3 CUTTING AND FITTING

Wherever possible, full units shall be used in lieu of cut units. Where cut units are required to accommodate the design, cutting shall be done by masonry mechanics using power masonry saws, except that cutting of units in unexposed work may be accomplished with masonry hammers and chisels. Wet-cut units shall be dried to the same surface-dry appearance as uncut units before being placed in the work. Cut edges shall be clean, true, and sharp. Openings to accommodate pipes, conduits, and other accessories shall be neatly formed so that framing or escutcheons required will completely conceal the cut edges. Cutting of webs of hollow units shall be kept to a minimum. Insofar as practicable, all cutting and fitting shall be accomplished while masonry work is being erected.

3.4 CLAY OR SHALE BRICK

When being laid, brick shall have suction sufficient to hold the mortar and to absorb water from the mortar, but shall be damp enough to allow the mortar to remain in a plastic state to permit the brick to be leveled and plumbed immediately after being laid without destroying the bond. Brick with frogging shall be laid frog side down and the better or face side exposed to view. Brick that is cored, recessed, or otherwise deformed shall not be used in sills, treads, soldier courses, or in any other areas where deformations may be exposed to view.

3.5 JOINTING

Joint widths shall be uniform and such that the specified widths are maintained throughout. Joints in concealed masonry surfaces and joints at top of electrical boxes in wet areas shall be cut flush with the masonry surfaces. Joints indicated to be caulked shall be raked a depth of 3/4 inch. Interior control joints shall be raked to a depth of

1/4 inch. All other joints shall be tooled slightly concave. Tooling shall be accomplished when mortar is thumbprint hard and in a manner that will compress and seal the mortar joint and produce joints of straight and true lines free of tool marks.

3.5.1 Brick Joints

Joints in brick construction shall be of thickness equal to the difference between the actual and nominal dimensions of the brick in either height or length, but in no case shall the joints be less than 1/4 inch nor more than 1/2 inch wide.

3.6 ANCHORAGE AND JOINT REINFORCEMENT

Spacing of joint reinforcement and type and spacing of anchors shall be as indicated. Joint reinforcement shall be continuous except at expansion or control joints. Splices in joint reinforcement shall be lapped at least 6 inches. Where walls or partitions intersect to form T-sections, the intersecting walls shall be anchored together with rigid steel anchors or joint reinforcement as indicated. Nail-on ties shall be attached to metal framing with stainless steel or plastic coated galvanized steel self-tapping metal screws. Screws shall be of a length to be fully engaged with the metal framing. A washer of neoprene or other similar material shall be inserted between the sheathing and the screw head or tie.

3.7 EXPANSION JOINTS

Expansion joints shall be located as indicated.

3.8 SILLS, LINTELS, AND COPINGS

Sills, lintels, and copings shall be set in a full bed of mortar with faces plumb and true.

3.9 DISCONTINUOUS WORK

When necessary to temporarily discontinue the work, masonry units shall be stepped back for joining when work resumes. Toothing may be resorted to only when specifically approved. Before resuming work, loose mortar shall be removed and the exposed joint shall be thoroughly cleaned. Top of walls exposed to rain or snow shall be covered with nonstaining waterproof covering or membrane when work is not in process. Covering shall extend a minimum of 2 feet down on each side of the wall and be held securely in place.

3.10 CLEANING

Mortar daubs or splashings, before setting or hardening, shall be completely removed from masonry unit surfaces that will be exposed or painted. Before completion of the work, all defects in joints of masonry to be exposed or painted shall be raked out as necessary, filled with mortar, and tooled to match existing joints. Masonry surfaces shall not be cleaned, other than removing excess surface mortar, until mortar in joints has hardened. Cleaning shall be accomplished with the use of stiff bristle fiber brushes, wooden paddles, wooden scrapers, or other suitable nonmetallic tools. Masonry surfaces shall be left clean, free of mortar daubs, dirt, stain, and discoloration, including scum from cleaning operations, and with tight mortar joints throughout.

3.10.1 CLAY-BRICK OR SHALE-BRICK SURFACES

The masonry surfaces shall be saturated with water and cleaned with a proprietary masonry cleaning agent recommended by the clay products manufacturer and that will not adversely affect the masonry surfaces. Proprietary cleaning agents shall be used in conformance with the cleaning product manufacturer's printed recommendations. Efflorescence or other similar stains shall be removed in conformance with the recommendations of the masonry unit manufacturer.

(END OF SECTION)

SECTION 05500**MISCELLANEOUS METAL****PART 1 GENERAL****1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI MH28.1 (1982) Design, Testing, Utilization, and Application of Industrial Grade Steel Shelving

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36 (1994a) Carbon Structural Steel

ASTM A 123 (1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A 653 (1995) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM A 924 (1995) General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1 (1994) Structural Welding Code - Steel

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM MBG 531 (1988; MBG 531S-89) Metal Bar Grating Manual

1.2 SUBMITTALS

The following shall be submitted:

Drawings

Miscellaneous Metal Items;

Detail drawings indicating material thickness, type, grade, and class, dimensions; and construction details. Shop drawings shall include erection details, and installation instructions, and templates.

Detail drawings for the following items:

Steel Canopy

1.3 GENERAL REQUIREMENTS

The Contractor shall verify all measurements and shall take all field measurements necessary before fabrication. Welding to or on structural steel shall be in accordance with AWS D1.1. Items specified to be galvanized, when practicable and not indicated otherwise, shall be hot-dip galvanized after fabrication. Galvanizing shall be in accordance with ASTM A 123, ASTM A 653, or ASTM A 924, as applicable. Exposed fastenings shall be compatible materials, shall generally match in color and finish, and shall harmonize with the material to which fastenings are applied. Materials and parts necessary to complete each item, even though such work is not definitely shown or specified, shall be included. Poor matching of holes for fasteners shall be cause for rejection. Fastenings shall be concealed where practicable. Thickness of metal and details of assembly and supports shall provide strength and stiffness. Joints exposed to the weather shall be formed to exclude water.

1.4 DISSIMILAR MATERIALS

Where dissimilar metals are in contact, or absorptive materials subject to wetting, the surfaces shall be protected with a coat of bituminous paint or asphalt varnish.

1.5 WORKMANSHIP

Miscellaneous metalwork shall be well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching shall produce clean true lines and surfaces. Welding shall be continuous along the entire area of contact except where tack welding is permitted. Exposed connections of work in place shall not be tack welded. Exposed welds shall be ground smooth. Exposed surfaces of work in place shall have a smooth finish, and unless otherwise approved, exposed riveting shall be flush. Where tight fits are required, joints shall be milled. Corner joints shall be coped or mitered, well formed, and in true alignment. Work shall be accurately set to established lines and elevations and securely fastened in place. Installation shall be in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

1.6 ANCHORAGE

Anchorage shall be provided where necessary for fastening miscellaneous metal items securely in place. Anchorage not otherwise specified or indicated shall include slotted inserts made to engage with the anchors, expansion shields, and power-driven fasteners when approved for concrete; and machine and carriage bolts for steel.

PART 2 PRODUCTS

2.1 SHOP PAINTING

Surfaces of ferrous metal except galvanized surfaces, shall be cleaned and shop coated with the manufacturer's standard protective coating unless otherwise specified. Surfaces of items to be embedded in concrete shall not be painted. Items to be finish painted shall be prepared according to manufacturer's recommendations or as specified.

2.2 Omitted

2.3 Omitted

2.4 STEEL CONSTRUCTION (canopy)

Steel structure shall be complete with structural steel tubes, pipe columns, mounting plates and necessary bolts and other fastenings as indicated or required. Structural steel shall conform to ASTM A 36. All steel shall be shop primed. Field finish coats shall be applied as specified in SECTION 09900, PAINTING. Roofing shall be as specified in SECTION 13120, STANDARD METAL BUILDING SYSTEMS.

2.5 MISCELLANEOUS

Miscellaneous plates and shapes for items that do not form a part of the structural steel framework, such as brick lintels, sill angles, miscellaneous mountings, shall be provided as required. Items not to be painted such as brick lintels shall be galvanized. Steel roof decking shall be provided for canopy as indicated on the drawings.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

All items shall be installed at the locations shown. Items listed below require additional procedures as specified.

None

(END OF SECTION)

SECTION 07270**FIRESTOPPING****PART 1 GENERAL****1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 84 (1994) Surface Burning Characteristics of Building Materials

ASTM E 814 (1994b) Fire Tests of Through-Penetration Fire Stops

UNDERWRITERS LABORATORIES (UL)

UL-05 (1994; Supple) Fire Resistance Directory

UL 723 (1993; Rev Apr 1994) Test for Surface Burning Characteristics of Building Materials

UL 1479 (1994) Fire Tests of Through-Penetration Firestops

1.2 Omitted.**1.3 GENERAL REQUIREMENTS**

Firestopping shall consist of furnishing and installing a material or a combination of materials to form an effective barrier against the spread of flame, smoke and gases, and maintain the integrity of fire resistance rated walls, partitions, floors, and ceiling-floor assemblies, including through-penetrations and construction joints.

Through-penetrations include the annular space around pipes, tubes, conduit, wires, cables and vents. Construction joints include those used to accommodate expansion, contraction, wind, or seismic movement; firestopping material shall not interfere with the required movement of the joint.

1.4 STORAGE AND DELIVERY

Materials shall be delivered in the original unopened packages or containers showing name of the manufacturer and the brand name. Materials shall be stored off the ground and shall be protected from damage and exposure to elements. Damaged or deteriorated materials shall be removed from the site.

1.5 NOT APPLICABLE**1.6 INSTALLER QUALIFICATIONS**

Each installer of firestopping material shall be trained and have a minimum of 3 years experience in the installation of firestopping of the type specified.

PART 2 PRODUCTS**2.1 FIRESTOPPING MATERIALS**

Firestopping materials shall consist of commercially manufactured products complying with the following minimum requirements:

2.1.1 Fire Hazard Classification

Material shall have a flame spread of 25 or less, and a smoke developed rating of 50 or less, when tested in accordance with ASTM E 84 or UL 723. Material shall be an approved firestopping material as listed in UL-05.

2.1.2 Toxicity

Material shall be nontoxic to humans at all stages of application.

2.1.3 Fire Resistance Rating

Firestopping will not be required to have a greater fire resistance rating than that of the assembly in which it is being placed.

2.1.3.1 Through-Penetrations

Firestopping materials for through-penetrations, as described in paragraph GENERAL REQUIREMENTS, shall provide "F" and "T" fire resistance ratings in accordance with ASTM E 814 or UL 1479, except that T Ratings are not required for penetrations smaller than or equal to a 100 mm (4 inch) nominal pipe or 0.01 square meter (16 square inches) in overall cross sectional area. Fire resistance ratings shall be the following:

- a. Penetrations of Fire Resistance Rated Walls and Partitions: F Rating = 1 hour, T Rating = 1 hour.

2.1.3.2 Construction Joints and Gaps

Fire resistance ratings of construction joints, as described in paragraph GENERAL REQUIREMENTS, and gaps such as those between floor slabs or roof decks and curtain walls shall be the same as the construction in which they occur.

PART 3 EXECUTION

3.1 PREPARATION

Areas to receive firestopping shall be free of dirt, grease, oil, or loose materials which may affect the fitting or fire resistance of the firestopping system.

3.2 INSTALLATION

Firestopping material shall completely fill void spaces regardless of geometric configuration, subject to tolerance established by the manufacturer. Firestopping for filling floor voids 100 mm (4 inches) or more in any direction shall be capable of supporting the same load as the floor is designed to support or shall be protected by a permanent barrier to prevent loading or traffic in the firestopped area. Firestopping shall be installed in accordance with manufacturer's written instructions. Firestopping shall be provided in the following locations, except in floor slabs on grade:

- a. Penetrations of duct, conduit, tubing, cable and pipe through floors and through fire-resistance rated walls, partitions, and ceiling-floor assemblies.
- b. Penetrations of vertical shafts such as pipe chases, elevator shafts, and utility chutes.
- c. Other locations where required to maintain fire resistance rating of the construction.

3.3 INSPECTION

Firestopped areas shall not be covered or enclosed until inspection is complete and approved. Contractor shall ensure that the completed work has been accomplished according to the manufacturer's written instructions and the specified requirements.

(END OF SECTION)

SECTION 07920**JOINT SEALING****PART 1 GENERAL****1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 920 (1987) Elastomeric Joint Sealants

ASTM D 1056 (1991) Flexible Cellular Materials - Sponge or Expanded Rubber

1.2 ENVIRONMENTAL REQUIREMENTS

The ambient temperature shall be within the limits of 4 to 32 degrees C (40 to 90 degrees F) when the sealants are applied.

1.3 DELIVERY AND STORAGE

Materials shall be delivered to the job in the manufacturer's original unopened containers. The container label or accompanying data sheet shall include the following information as applicable: manufacturer, name of material, formula or specification number, lot number, color, date of manufacture, mixing instructions, shelf life, and curing time at the standard conditions for laboratory tests. Materials shall be handled and stored to prevent inclusion of foreign materials. Materials shall be stored at temperatures between 4 and 32 degrees C (40 and 90 degrees F) unless otherwise specified by the manufacturer.

PART 2 PRODUCTS**2.1 BACKING**

Backing shall be 25 to 33 percent oversize for closed cell and 40 to 50 percent oversize for open cell material, unless otherwise indicated.

2.1.1 Rubber Backing

Cellular rubber sponge backing shall be ASTM D 1056, Type 2, closed cell, Class A Grade, round cross section.

2.2 BOND-BREAKER

Bond-breaker shall be as recommended by the sealant manufacturer to prevent adhesion of the sealant to backing or to bottom of the joint.

2.3 PRIMER

Primer shall be non-staining type as recommended by sealant manufacturer for the application.

2.4 ELASTOMERIC SEALANTS

Elastomeric sealants shall conform to ASTM C 920 and the following:

a. Polyurethane Sealant for use in joints in concrete slabs: Polyurethane sealant, Type S, Grade NS, Class 25, Use T.

b. Polyurethane Sealant for use in joints at windows and doors, sleeves and pipe penetrations, ductwork openings through interior and exterior walls, and other joints for buildings: Polyurethane sealant, Type S, Grade NS, Class 25, Use NT.

2.5 SOLVENTS AND CLEANING AGENTS

Solvents, cleaning agents and accessory materials shall be provided as recommended by the manufacturer.

PART 3 EXECUTION

3.1 GENERAL

3.1.1 Surface Preparation

The surfaces of joints to be sealed shall be dry. Oil, grease, dirt, chalk, particles of mortar, dust, loose rust, loose mill scale, and other foreign substances shall be removed from surfaces of joints to be in contact with the sealant. Oil and grease shall be removed with solvent and surfaces shall be wiped dry with clean cloths.

3.1.2 Concrete and Masonry Surfaces

Where surfaces have been treated with curing compounds, oil, or other such materials, the materials shall be removed by sandblasting or wire brushing. Laitance, efflorescence and loose mortar shall be removed from the joint cavity.

3.1.3 Steel Surfaces

Steel surfaces to be in contact with sealant shall be sandblasted or, if sandblasting would not be practical or would damage adjacent finish work, the metal shall be scraped and wire brushed to remove loose mill scale. Protective coatings on steel surfaces shall be removed by sandblasting or by a solvent that leaves no residue.

3.1.4 Aluminum Surfaces

Aluminum surfaces to be in contact with sealants shall be cleaned of temporary protective coatings. When masking tape is used for a protective cover, the tape and any residual adhesive shall be removed just prior to applying the sealant. Solvents used to remove protective coating shall be as recommended by the manufacturer of the aluminum work and shall be non-staining.

3.2 APPLICATION

3.2.1 Masking Tape

Masking tape may be placed on the finish surface on one or both sides of a joint cavity to protect adjacent finish surfaces from primer or sealant smears. Masking tape shall be removed within 10 minutes after joint has been filled and tooled.

3.2.2 Backing

Backing shall be installed to provide the indicated sealant depth. The installation tool shall be shaped to avoid puncturing the backing.

3.2.3 Bond-Breaker

Bond-breaker shall be applied to fully cover the bottom of the joint without contaminating the sides where sealant adhesion is required.

3.2.4 Primer

Primer shall be used on concrete masonry units, wood, or other porous surfaces in accordance with instructions furnished with the sealant. Primer shall be applied to the joint surfaces to be sealed. Surfaces adjacent to joints shall not be primed.

3.2.5 Sealant

Sealant shall be used before expiration of shelf life. Sealant in guns shall be applied with a nozzle of proper size to fit the width of joint. Sealant shall be forced into joints with sufficient pressure to expel air and fill the groove solidly. Sealant shall be installed to the indicated depth without displacing the backing. Unless otherwise indicated, specified, or recommended by the manufacturer, the installed sealant shall be tooled so that the surface is uniformly smooth and free of wrinkles and to assure full adhesion to the sides of the joint. Sealants shall be installed free of air pockets, foreign embedded matter, ridges and sags. Sealer shall be applied over the sealant when and as specified by the sealant manufacturer.

3.3 CLEANING

The surfaces adjoining the sealed joints shall be cleaned of smears and other soiling resulting from the sealant application as work progresses.

(END OF SECTION)

SECTION 08110**STEEL DOORS AND FRAMES****PART 1 GENERAL****1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 236	(1989; R 1993) Steady-State Thermal Performance of Building Assemblies by Means of a Guarded Hot Box
ASTM C 976	(1990) Thermal Performance of Building Assemblies by Means of a Calibrated Hot Box
ASTM D 2863	(1991) Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)
ASTM E 283	(1991) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

DOOR AND HARDWARE INSTITUTE (DHI)

DHI-A115.IG	(1994) Installation Guide for Doors and Hardware
-------------	--

STEEL DOOR INSTITUTE (SDOI)

SDOI SDI-100	(1991) Standard Steel Doors and Frames
SDOI SDI-106	(1991) Standard Door Type Nomenclature
SDOI SDI-107	(1984) Hardware on Steel Doors (Reinforcement - Application)

1.2 SUBMITTALS

The following shall be submitted:

Drawings

Steel Doors and Frames;

Drawings/schedules using standard door type nomenclature in accordance with SDOI SDI-106 indicating the location of each door and frame, elevation of each model of door and frame, details of construction, method of assembling sections, location and extent of hardware reinforcement, hardware locations, type and location of anchors for frames, and thicknesses of metal. Drawings shall include catalog cuts or descriptive data for the doors, frames, and weather-stripping including air infiltration data and manufacturers printed instructions.

1.3 DELIVERY AND STORAGE

During shipment, welded unit type frames shall be strapped together in pairs with heads at opposite ends or shall be provided with temporary steel spreaders at the bottom of each frame; and knockdown type frames shall be securely strapped in bundles. Materials shall be delivered to the site in undamaged condition, and stored out of contact with the ground and under a weathertight covering permitting air circulation. Doors and assembled frames shall be stored in an upright position in accordance with DHI-A115.IG. Abraded, scarred, or rusty areas shall be cleaned and touched up with matching finishes.

1.4 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

PART 2 PRODUCTS

2.1 DOORS AND FRAMES

Doors and frames shall be factory fabricated in accordance with SDOI SDI-100 and the additional requirements specified herein. Door grade shall be heavy duty (Grade II) unless otherwise indicated on the door and door frame schedules. Exterior doors and frames shall be designation A60 galvanized. Interior doors and frames at restrooms shall be designation A60 galvanized. Doors and frames shall be prepared to receive hardware conforming to the templates and information provided under Section 08700 BUILDERS' HARDWARE. Doors and frames shall be reinforced, drilled, and tapped to receive mortised hinges, locks, latches, and flush bolts as required. Doors and frames shall be reinforced for surface applied hardware. Frames shall be welded type located as shown. Door frames shall be furnished with a minimum of three jamb anchors and one floor anchor per jamb. Anchors shall be not less than 1.2 mm (18 gauge) steel or 4.5 mm (7 gauge) diameter wire. For wall conditions that do not allow the use of a floor anchor, an additional jamb anchor shall be provided. Rubber silencers shall be furnished for installation into factory predrilled holes in door frames; adhesively applied silencers are not acceptable. Reinforcing of door assemblies for closers and other required hardware shall be in accordance with SDOI SDI-100 and the conditions of the fire door assembly listing when applicable. Exterior doors shall have top edges closed flush and sealed against water penetration.

2.3 THERMAL INSULATED DOORS

The interior of all doors leading to heated areas shall be completely filled with rigid plastic foam permanently bonded to each face panel. The thermal conductance (U-value) through the door shall not exceed 2.33 W/sq. m times K (0.41 Btu/hr times sq. f times f) when tested as an operational assembly in accordance with ASTM C 236 or ASTM C 976. Doors with cellular plastic cores shall have a minimum oxygen index rating of 22 percent when tested in accordance with ASTM D 2863.

2.4 OMITTED

2.5 OMITTED

2.6 WEATHERSTRIPPING

Unless otherwise specified in Section 08700 BUILDERS' HARDWARE, weatherstripping shall be as follows: Weatherstripping for all exterior door heads and jambs shall be manufacturer's standard elastomeric type of synthetic rubber, vinyl, or neoprene and shall be installed at the factory or on the jobsite in accordance with the door frame manufacturer's recommendations. Weatherstripping for bottom of doors shall be as shown. Air leakage rate of weatherstripping shall not exceed 0.31 l/s per linear meter (0.20 cfm per linear foot) of crack when tested in accordance with ASTM E 283 at standard test conditions.

2.7 OMITTED

2.8 LOUVERS

Where indicated, doors shall be provided with louver sections. Louvers shall be sightproof type inserted into the door. Pierced louvers shall not be used on exterior doors. Inserted louvers shall be stationary. Louvers shall be non-removable from the outside of exterior doors. Insect screens shall be a removable type with 18 by 16 mesh aluminum or bronze cloth. Louvers shall be pre-finished same as the door.

2.9 OMITTED

2.10 FACTORY PRIMED FINISH

Galvanized doors and frames shall be shipped phosphatized and primed.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall be in accordance with DHI-A115.IG. Preparation for surface applied hardware shall be in accordance with SDOI SDI-107. Rubber silencers shall be installed in door frames after finish painting has been completed; adhesively applied silencers are not acceptable. Weatherstripping shall be installed at door openings leading to heated areas to provide a weathertight installation.

3.1.1 Thermal Insulated Doors

Hardware and perimeter seals shall be adjusted for proper operation. Doors shall be sealed weathertight after installation of hardware.

3.2 FIELD PAINTING

Steel doors and frames shall be painted in accordance with Section 09900 PAINTING, GENERAL. Weatherstrips shall be protected from paint. Final finish shall be free of scratches or other blemishes.

(END OF SECTION)

SECTION 08120**ALUMINUM DOORS AND FRAMES****PART 1 GENERAL****1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 605.2 (1992; Addenda Feb 1994)&\ Voluntary Specification for High Performance Organic Coatings on Architectural Aluminum Extrusions and Panels

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 209 (1996) Aluminum and Aluminum-Alloy Sheet and Plate

ASTM B 221 (1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes

ASTM E 283 (1991) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

ASTM E 330 (1990) Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference

1.2 SYSTEM DESCRIPTION

Swing-type aluminum doors and frames, of size and design shown on the drawings, shall be provided at the locations indicated. Doors and windows shall be furnished complete with subframes, transoms, adjoining sidelights, trim, and other accessories indicated and specified.

1.3 PERFORMANCE REQUIREMENTS**1.3.1 Wind Load Performance**

Full-glazed doors shall pass the following test:

The test section shall consist of an assembly of the top corner of the door. The side-rail section shall be 24 inches long and the top-rail section shall be 12 inches long. The top-rail section of doors having tie rods extending between stiles shall have blocking at the section cut to provide anchorage for the tie rod. The top-rail section shall be anchored to the test bench so that the corner protrudes far enough to allow clearance for deflection of the side rail. A lever arm capable of supporting 190 pounds shall be attached to the side-rail section at a point 19 inches from the inside edge of the top-rail. Position of the lever arm shall be parallel to the top-rail section. A weight support pad shall be attached to the lever arm at a point 19 inches from the inner edge of the side rail. The test section shall withstand a load of 170 pounds on the lever arm before reaching the point of failure. Failure is defined as a joint separation of 1/16 inch during test loading or a vertical rail rotational displacement of 3-1/2 degrees during test loading.

1.3.2 Wind Load Performance

Doors shall be of sufficient strength to withstand a design wind load of 30 pounds per square foot of supported area with a deflection of not more than 1/175 times the length of the member. Doors shall be tested in accordance with ASTM E 330 at a pressure not less than 1.5 times the design load. Doors shall be of sufficient strength to withstand a design wind load of 1440 Pa (30 pounds per square foot) of supported area with a deflection of not more than 1/175 times the length of the member. Doors shall be tested in accordance with ASTM E 330 at a pressure not less than 1.5 times the design load.

1.4 SUBMITTALS

The following shall be submitted:

Data

Aluminum Doors and Frames; Frames For Windows

Manufacturer's descriptive data and catalog cuts including air-infiltration data.

Drawings

Aluminum Doors and Frames; Frames For Windows

A schedule showing the location of each door and window shall be included with the drawings. Drawings showing elevations of each door and frame type, details and method of anchorage, details of construction, location and installation of hardware, shape and thickness of materials, and details of joints and connections.

Reports

Flush Doors:

For full-glazed doors, certified test reports stating that doors meet all test and specified requirements. Tests shall be conducted by an independent testing laboratory within a period of 36 months preceding delivery of the doors to the site.

1.5 DELIVERY AND STORAGE

Materials delivered to the jobsite shall be inspected for damage, and shall be unloaded with a minimum of handling. Storage shall be in a dry location with adequate ventilation, free from dust, water, and other contaminants, and which permits easy access for inspecting and handling. Materials shall be neatly stored on the floor, properly stacked on nonabsorptive strips or wood platforms. Doors and frames shall not be covered with tarps, polyethylene film, or similar coverings.

1.6 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one-year period shall be provided.

PART 2 PRODUCTS

2.1 ALUMINUM DOORS AND FRAMES

Extrusions shall comply with ASTM B 221, Alloy 6063-T5 except alloy used for anodized color coatings shall be required to produce the specified color. Aluminum sheets and strips shall comply with ASTM B 209, alloy and temper best suited for the purpose. Fasteners shall be hard aluminum or stainless steel.

2.1.1 Finishes

Finish shall be a fluoropolymer paint that meets or exceeds AAMA 605.2-2. (Example: Kawneer “Fluoropan or Permadyne finish”.) Color shall be selected from manufacturer’s standards.

2.1.2 Welding and Fastening

Where possible, welds shall be located on unexposed surfaces. Welds required on exposed surfaces shall be smoothly dressed. Welding shall produce a uniform texture and color in the finished work, free of flux and spatter. Exposed screws or bolts will be permitted only at inconspicuous locations and shall have heads countersunk.

2.1.3 Anchors

Anchors shall be stainless steel or steel with a hot-dipped galvanized finish. Anchors of the sizes and shapes required shall be provided for securing aluminum frames to adjacent construction. Anchors shall be placed near top and bottom of each jamb and at intermediate points not more than 625 mm (25 inches) apart. Transom bars shall be anchored at ends, and mullions shall be anchored at head and sill. The bottom of each frame shall be anchored to the rough floor construction with 2.4 mm (3/32 inch) (3/32 inch) thick stainless steel angle clips secured to the back of each jamb and to floor construction. Stainless steel bolts and expansion rivets shall be used for fastening clip anchors.

2.1.4 Provisions For Hardware

Hardware for aluminum doors is specified in Section 08700 BUILDERS' HARDWARE. Doors and frames shall be cut, reinforced, drilled, and tapped at the factory to receive template hardware. Reinforcement shall be provided in the core of doors as required to receive locks, door closures, and other hardware. Doors to receive surface applied hardware shall be reinforced as required.

2.1.5 Provisions For Glazing

Glazing shall be as indicated on the drawings. Metal glazing beads, vinyl inserts, and glazing gaskets shall be provided for securing glass. Glass stops shall be tamperproof on exterior side.

2.1.6 Weatherstripping

Weatherstripping shall be continuous silicone-treated wool pile type, or a type recommended by the door manufacturer, and shall be provided on head and jamb of exterior doors. Weatherstripping for bottom of doors shall be as shown. Weatherstripping shall be easily replaced without special tools, and shall be adjustable at meeting stiles of pairs of doors. Air leakage rate of weatherstripping shall not exceed 0.775 L/s per lineal meter (0.5 cubic feet per minute per lineal foot) of crack when tested in accordance with ASTM E 283 at standard test conditions.

2.2 FABRICATION OF ALUMINUM FRAMES

Frames shall be double-glazed and shall have a minimum total average unit thermal resistance of 0.34 square meter degree K per W (R value 1.92). Frames shall be fabricated of extruded aluminum shapes to contours as shown on the drawings. Shapes shown are representations of design, function, and required profile. Dimensions shown are minimum. Shapes of equivalent design may be submitted, subject to approval of samples. Minimum metal wall thickness shall be 0.125 inches except glazing beads, moldings, and trim shall be not less than 0.050 inches. Frames that are to receive glass shall have removable snap-on glass stops and glazing beads. Joints in frame members shall be milled to a hairline watertight fit, reinforced, and secured mechanically by steel clip arrangement or by screw spline attachment.

2.3 FABRICATION OF ALUMINUM DOORS

2.3.1 Sizes, Clearances, and Edge Treatment

Doors shall be not less than 44.4 mm (1-3/4 inches) thick. Clearances shall be 1.6 mm (1/16 inch) at hinge stiles, 3 mm (1/8 inch) at lock stiles and top rails, and 5 mm (3/16 inch) at floors and thresholds. Single-acting doors shall be beveled 3 mm (1/8 inch) at lock and meeting stile edges.

2.3.1.1 Full-Glazed Stile and Rail Doors

Doors shall have narrow stiles and rails as shown, and shall be fabricated from extruded aluminum hollow seamless tubes or from a combination of open-shaped members interlocked or welded together. Doors shall be double-glazed and shall have a minimum total average unit thermal resistance of 0.34 square meter degree K per W (R-value 1.92). Top and bottom rail shall be fastened together by means of welding. An adjustable mechanism shall be provided in the top rail of narrow stile doors to allow for minor clearance adjustments after installation. Extruded aluminum snap-in glazing beads or glazing beads formed of EPDM elastomeric extrusions shall be provided on interior side of doors. Extruded aluminum theft-proof snap-in glazing beads or fixed glazing beads shall be provided on exterior or security side of doors. Glazing beads shall have vinyl insert glazing gaskets, designed to receive glass of thickness required. Glass is specified in Section 08810 GLASS AND GLAZING. Thermal barrier in insulated frame sections shall consist of a dual purpose exterior gasket that eliminates all metal to metal contact between exterior and interior of frame. Glazing gaskets for insulated frames shall be EPDM elastomeric extrusions in doors and for interior glazing face of frame.

PART 3 EXECUTION

3.1 INSTALLATION OF DOORS, FRAMES, AND ACCESSORIES

3.1.1 Protection of Aluminum

Aluminum shall not be used where it will be in contact with copper or where it will contact water which flows over copper surfaces. Aluminum that will be in contact with wet or pressure-treated wood, mortar, concrete, masonry, or ferrous metals shall be protected against galvanic or corrosive action by one of the following methods.

3.1.1.2 Nonabsorptive Tape or Gasket

Nonabsorptive tape or gasket shall be placed between the adjoining surfaces and shall be cemented to the aluminum surface using a cement compatible with aluminum.

3.1.2 Installation

Frames and framing members shall be accurately set in position to receive doors, transoms, and adjoining sidelights. Frames shall be plumb, square, level, and in alignment, and securely anchored to adjacent construction. Metal-to-metal joints between framing members shall be sealed as specified in Section 07920 JOINT SEALING. Doors shall be accurately hung with proper clearances, and adjusted to operate properly. Protective coverings if provided shall be removed and the doors and frames shall be thoroughly cleaned.

(END OF SECTION)

SECTION 08330**OVERHEAD ROLLING DOORS****PART 1 GENERAL****1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 525 (1991b) General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process

ASTM E 84 (1991a) Surface Burning Characteristics of Building Materials

**AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND
AIR-CONDITIONING ENGINEERS (ASHRAE)**

ASHRAE-81903 (1993; Errata) Handbook, Fundamentals I-P Edition

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2 (1993) Industrial Control Devices, Controllers and Assemblies

NEMA ICS 6 (1993) Enclosures for Industrial Control and Systems

NEMA MG 1 (1993; Rev 1-1993; Rev 2-1995) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1996) National Electrical Code

1.2 DESCRIPTION

Overhead rolling doors shall be spring counterbalanced, rolling type, with interlocking slats, complete with guides, fastenings, hood, brackets, and operating mechanisms, and shall be designed for use on openings as indicated.

1.2.1 Wind Load Requirements

Doors and components shall be designed to withstand the minimum design wind load of 41 psf. Doors shall be constructed to sustain a superimposed load, both inward and outward, equal to 1-1/2 times the minimum design wind load. The door shall support the superimposed loads for a minimum period of 10 seconds without evidence of serious damage and shall be operable after conclusion of the tests. Test data showing compliance with design windload requirements for the door design tested in accordance with a uniform static load equal to 1-1/2 times the minimum design windload, shall be provided. The uniform static load test specimen shall be supported using guides, endlocks, and windlocks as required for project installation. Recovery shall be at least 3/4 of the maximum deflection within 24 hours after the test load is removed.

1.2.2 Operational Cycle Life

All portions of the door and door operating mechanism that are subject to movement, wear, or stress fatigue shall be designed to operate through a minimum of 50,000 cycles. (One complete cycle of door operation will begin with the

door in the closed position, move to the full open position and return to the closed position.)

1.3 SUBMITTALS

The following shall be submitted:

Data

Overhead Rolling Door Unit

Manufacturer's catalog data, test data, and summary of forces and loads on the walls/jambs.

Drawings

Overhead Rolling Door Unit

Drawings shall include elevations of the door type, details and method of anchorage, details of construction, location and installation of hardware, shape and thickness of materials, details of joints and connections, and details of guides, power operators, controls, and other fittings.

Operation and Maintenance Manuals

Overhead Rolling Door Unit

Six complete copies of operating instructions outlining the step-by-step procedures required for operating door. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Six complete copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, troubleshooting guides, and simplified diagrams for the equipment as installed. Also spare parts data for each different item of material and equipment specified. The data shall include a complete list of parts and supplies, source of supply, and a list of the high mortality maintenance parts.

1.4 DELIVERY AND STORAGE

Doors shall be delivered to the job site wrapped in a protective covering with the brands and names clearly marked thereon. Doors shall be stored in a dry location that is adequately ventilated and free from dirt and dust, water, and other contaminants, and in a manner that permits easy access for inspection and handling.

1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1-year period shall be provided.

PART 2 PRODUCTS

2.1 OVERHEAD ROLLING DOORS

Doors shall be surface-mounted type with guides at jambs set back a sufficient distance to clear the opening.

2.1.1 Curtains

The curtains shall roll up on a barrel supported at the head of opening on brackets, and shall be balanced by helical springs. Steel slats for doors less than 15 feet wide shall be minimum bare metal thickness of 20 gauge.

2.1.1.1 Insulated Curtains

The slat system shall supply a minimum R-value of 5 when calculated in accordance with ASHRAE-81930. Slat shall be of the flat type as standard with the manufacturer. Slat shall consist of a urethane core not less than 11/16 inch thick, completely enclosed within metal facings. Exterior face of slats shall be gauge as specified for curtains. Interior face shall be not lighter than 24 gauge. Insulation shall have a flame spread rating of not more than 25 and a smoke development factor of not more than 50 when tested in accordance with ASTM E 84.

2.1.2 Endlocks

The ends of each alternate slat for interior doors shall have malleable endlocks of manufacturer's stock design.

2.1.3 Bottom Bar

The curtain shall have a standard bottom bar consisting of two hot-dip galvanized steel angles for steel doors.

2.1.4 Guides

Guides shall be steel structural shapes or formed steel shapes, of a size and depth to provide proper clearance for operation. Guides shall be attached to adjoining construction with fasteners recommended by the manufacturer.

2.1.5 Barrel

The barrel shall be steel pipe or commercial welded steel tubing of diameter for the size of curtain. Deflection shall not exceed 2.5 mm per meter (0.03 inch per foot) of span. Ends of the barrel shall be closed with cast-iron or steel plugs, machined to fit the pipe.

2.1.6 Springs

Oil tempered helical steel counter-balance torsion springs shall be installed within the barrel and shall be capable of producing sufficient torque to assure easy operation of the door curtain. Access shall be provided for spring tension adjustment from outside of the bracket without removing the hood.

2.1.7 Brackets

Brackets shall be of steel plates to close the ends of the roller-shaft housing, and to provide mounting surfaces for the hood. An operation bracket hub and shaft plugs shall have sealed prelubricated ball bearings.

2.1.8 Hoods

Hoods shall be steel, with minimum bare metal thickness of 0.70 mm (24 gauge), (0.0209 (24 gauge),) formed to fit contour of the end brackets, and shall be reinforced with steel rods, rolled beads, or flanges at top and bottom edges. Multiple segment and single piece hoods shall be provided with support brackets of the manufacturer's standard design as required for adequate support.

2.1.9 Electric Power Operator With Auxiliary Chain Hoist Operation

Electric power operators shall be heavy-duty industrial type. The unit shall operate the door through the operational cycle life specified. The electric power operator shall be complete with electric motor, auxiliary operation, necessary means of reduction, brake, mounting brackets, push button controls, limit switches, magnetic reversing starter, and all other accessories necessary to operate components specified in other paragraphs of this section. The operator shall be so designed that the motor may be removed without disturbing the limit-switches settings and without affecting the emergency chain operator. Doors shall be provided with an auxiliary operator for immediate

emergency manual operation of the door in case of electrical failure. The emergency manual operating mechanism shall be so arranged that it may be operated from the floor without affecting the settings of the limit switches. A mechanical device shall be included that will disconnect the motor from the drive operating mechanism when the auxiliary operator is used. Where control voltages differ from motor voltage, a control voltage transformer shall be provided in and as part of the electric power operator system. Control voltage shall not exceed 120 volts.

a. Motors: Drive motors shall conform to NEMA MG 1, shall be high-starting torque, reversible type, and shall be of sufficient wattage (horsepower) and torque output to move the door in either direction from any position at a speed range of 6 to 8 inches per second without exceeding the rated capacity. Motors shall be suitable for operation on 120 volts, 60 hertz, single phase current and shall be suitable for across-the-line starting. Motors shall be designed to operate at full capacity over a supply voltage variation of plus or minus 10 percent of the motor voltage rating. Motors shall be provided with overload protection.

b. Controls: Control equipment shall conform to NEMA ICS 2. Enclosures shall conform to NEMA ICS 6, Type 12 (industrial use), Type 7 or 9 in hazardous locations, in accordance with NFPA 70, Article 501, Section 50. Exterior control stations shall be weatherproof key-operated type with corrosion-resistant cast-metal cover. The interior control station shall be of the three position button or switch type, marked "OPEN," "CLOSE," and "STOP." The "OPEN" and "STOP" controls shall be of the momentary contact type with seal-in contact. The "CLOSE" control shall be of the constant pressure type. When the door is in motion and the "STOP" control is pressed, the door shall stop instantly and remain in the stop position; from the stop position, the door shall be operable in either direction by the "OPEN" or "CLOSE" controls. Controls shall be of the full-guarded type to prevent accidental operation. Readily adjustable limit switches shall be provided to automatically stop the doors at their fully open and closed positions.

c. Sensing Edge Device: The bottom edge of electric power operated doors shall have an electric sensing edge that will immediately reverse the door movement upon contact with an obstruction and cause the door to return to its full open position. The sensing edge shall not substitute for a limit switch. Exterior doors shall be provided with a combination compressible weather seal and sensing edge.

d. Electrical Work: Conduit and wiring necessary for proper operation shall be provided under Section 16415 ELECTRICAL WORK, INTERIOR. Flexible connections between doors and fixed supports shall be made with extra flexible type SJO cable, except in hazardous locations where wiring shall conform to NFPA 70, Article 501, 502, 503, or 504 as appropriate. The cable shall have a spring-loaded automatic take up reel or a coil cord equivalent device.

2.1.10 Finish

Steel slats and hoods shall be hot-dip galvanized G90 in accordance with ASTM A 525, and shall be treated for paint adhesion and shall receive a baked on prime coat and a baked on top coat. The paint system shall withstand a minimum of 1500 hours without blistering, bubbling, or rust. Surfaces other than slats and hood surfaces shall be cleaned and treated to assure maximum paint adherence and shall be given a factory dip or spray coat of rust inhibitive metallic oxide or synthetic resin primer.

PART 3 EXECUTION

3.1 INSTALLATION

Doors shall be installed in accordance with approved detail drawings and manufacturer's instructions. Anchors and inserts for guides, brackets, hardware, and other accessories shall be accurately located. Upon completion, doors shall be free from warp, twist, or distortion. Doors shall be lubricated, properly adjusted, and demonstrated to operate freely.

Field painting shall be in accordance with Section 09900 PAINTING, GENERAL.

(END OF SECTION)

SECTION 08520**ALUMINUM WINDOWS****PART 1 GENERAL****1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

- | | |
|-------------|---|
| AAMA 101 | (1993) Voluntary Specifications for Aluminum and Poly(Vinyl Chloride) (PVC) Prime Windows and Glass Doors |
| AAMA 603.8 | (1992) Voluntary Performance Requirement and Test Procedures for Pigmented Organic Coatings on Extruded Aluminum |
| AAMA 1503.1 | (1988) Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections |

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- | | |
|------------|--|
| ASTM E 283 | (1991) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E 330 (1990) Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
ASTM E 547 (1993) Water Penetration of Exterior Windows, Curtain Walls, and Doors by Cyclic Static Air Pressure Differential |
| ASTM E 330 | (1990) Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference |
| ASTM E 547 | (1993) Water penetration of Exterior Windows, Curtain Walls, Doors by Cyclic Static Air Pressure Differential |

1.2 WINDOW PERFORMANCE

Aluminum windows shall be designed to meet the following performance requirements. Testing requirements shall be performed by an independent testing laboratory or agency.

1.2.1 Structural Performance

Structural test pressures on window units shall be for positive load (inward) and negative load (outward) in accordance with ASTM E 330. After testing, there shall be no glass breakage, permanent damage to fasteners, hardware parts, support arms or actuating mechanisms or any other damage, which could cause window to be inoperable. There shall be no permanent deformation of any main frame, sash or ventilator member in excess of the requirements established by AAMA 101 for the window types and classification specified in this section.

1.2.2 Air Infiltration

Air infiltration shall not exceed the amount established by AAMA 101 for each window type when tested in accordance with ASTM E 283.

1.2.3 Water Penetration

Water penetration shall not exceed the amount established by AAMA 101 for each window type when tested in accordance with ASTM E 547.

1.2.4 Thermal Performance

Thermal transmittance for thermally broken aluminum windows with insulating glass shall not exceed R-Value Class 0.59 m/W (R3.33 0.44 m k/Q) when tested in accordance with AAMA 1503.1.

1.3 SUBMITTALS

The following shall be submitted:

Data

Aluminum Windows;

Manufacturer's descriptive data and catalog cut sheets.

Samples

Aluminum Windows;

Manufacturer's standard color samples

1.4 QUALIFICATION

Window manufacturer shall specialize in designing and manufacturing the type of aluminum windows specified in this section, and shall have a minimum of 5 years of documented successful experience. Manufacturer shall have the facilities capable of meeting contract requirements, single-source responsibility and warranty.

1.5 DELIVERY AND STORAGE

Aluminum windows shall be delivered to project site and stored in accordance with manufacturer's recommendations. Damaged windows shall be replaced with new windows.

1.6 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1-year period shall be provided.

PART 2 PRODUCTS

2.1 ALUMINUM WINDOW TYPES

Aluminum windows shall consist of complete units including sash, glass, frame, weatherstripping, and hardware. Windows shall conform to AAMA 101. Windows shall be double-glazed when tested in accordance with AAMA 1503.1. Operable windows shall permit cleaning the outside glass from inside the building.

2.1.1 Single-Hung Windows

Aluminum single-hung windows shall conform to AAMA 101, DH-C 20 type which operate vertically with the weight of sash offset by a counterbalancing mechanism mounted in window to hold the sash stationary at any open position. Windows shall be provided with a tilt-in sash. Single-hung windows shall be provided with keyed locking

devices to secure the sash in the closed position. Counterbalancing mechanisms shall be easily replaced after installation.

2.2 WEATHERSTRIPPING

Weatherstripping for ventilating sections shall be of type designed to meet water penetration and air infiltration requirements specified in this section in accordance with AAMA 101, and shall be manufactured of material compatible with aluminum and resistant to weather. Weatherstrips shall be factory-applied and easily replaced in the field. Neoprene or polyvinylchloride weatherstripping are not acceptable where exposed to direct sunlight.

2.3 Omitted

2.4 ACCESSORIES

2.4.1 Fasteners

Fastening devices shall be window manufacturer's standard design made from aluminum, non-magnetic stainless steel, cadmium-plated steel, nickel/chrome-plated steel or magnetic stainless steel in compliance with AAMA 101. Self-tapping sheet metal screws will not be acceptable for material thicker than 2 mm (1/16 inch).

2.4.2 Hardware

Hardware shall be as specified for each window type and shall be fabricated of aluminum, stainless steel, cadmium-plated steel, zinc-plated steel or nickel/chrome-plated steel of quality established by AAMA 101.

2.4.3 Window Anchors

Anchoring devices for installing windows shall be made of aluminum, cadmium-plated steel, stainless steel, or zinc-plated steel conforming to AAMA 101.

2.5 GLASS AND GLAZING

Units shall be complete with glass and glazing provisions to meet AAMA 101. Glazing material shall be compatible with aluminum, and shall not require painting. Glazing shall be tinted, insulated and shall be as described in SECTION 08810, GLASS AND GLAZING.

2.6 FINISH

2.6.1 Baked-Acrylic Resin-Based Coating

Exposed surfaces of aluminum windows shall be finished with acrylic resin-based coating conforming to AAMA 603.8, total dry thickness of 1.0 mil. Finish shall be free of scratches and other blemishes.

2.6.2 Color

Color shall be as selected from manufacturer's standards.

PART 3 EXECUTION

3.1 INSTALLATION

Aluminum windows shall be installed in accordance with approved shop drawings and manufacturer's published instructions. Aluminum surfaces in contact with masonry, concrete, wood and dissimilar metals other than stainless steel, zinc, cadmium or small areas of white bronze shall be protected from direct contact using protective materials

recommended by AAMA 101. The completed window installation shall be watertight in accordance with Section 07920 JOINT SEALING. Glass and glazing shall be installed in accordance with requirements of this section.

3.2 ADJUSTMENTS AND CLEANING

3.2.1 Hardware Adjustments

Final operating adjustments shall be made after glazing work is complete. Operating sash or ventilators shall operate smoothly and shall be weathertight when in locked position.

3.2.2 Cleaning

Aluminum window finish and glass shall be cleaned on exterior and interior sides in accordance with window manufacturer's recommendations. Alkaline or abrasive agents shall not be used. Precautions shall be taken to avoid scratching or marring window finish and glass surfaces.

(END OF SECTION)

SECTION 08700**BUILDERS' HARDWARE****PART 1 GENERAL****1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE /
BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.1	(1988) Butts and Hinges
ANSI/BHMA A156.2	(1989) Bored and Preassembled Locks and Latches
ANSI/BHMA A156.3	Directory of Certified Exit Devices
ANSI/BHMA A156.4	(1992) Door Controls - Closers
ANSI/BHMA A156.5	(1992) Auxiliary Locks & Associated Products
ANSI/BHMA A156.6	(1986) Architectural Door Trim
ANSI/BHMA A156.7	(1988) Template Hinge Dimensions
ANSI/BHMA A156.13	(1994) Mortise Locks & Latches
ANSI/BHMA A156.16	(1989) Auxiliary Hardware
ANSI/BHMA A156.18	(1987) Materials and Finishes
ANSI/BHMA A156.21	(1989) Thresholds

DOOR AND HARDWARE INSTITUTE (DHI)

DHI-02	(1986) Installation Guide for Doors and Hardware
DHI-03	(1989) Keying Systems and Nomenclature
DHI-04	(1976) Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames
DHI-05	(1990) Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames
DHI A115-W	(1993) Wood Door Hardware Standards (Incl A115-W1 thru A115-W9)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	(1986) Fire Doors and Windows
---------	-------------------------------

NFPA 101 (1994) Safety to Life from Fire in Buildings and Structures

NFPA 105 (1993) Smoke-Control Door Assemblies

1.2 SUBMITTALS

The following shall be submitted:

Schedules

Hardware Schedule

Hardware schedule listing all items to be furnished. The schedule shall include for each item: the quantities; manufacturer's name and catalog numbers; sizes; detail information or catalog cuts; finishes; door and frame size and materials; location and hardware set identification cross-references to drawings; corresponding reference standard type number or function number from manufacturer's catalog if not covered by ANSI or BHMA; and list of abbreviations and template numbers.

Keying Schedule

Keying schedule developed in accordance with DHI-03, after the keying meeting with the user.

1.3 DELIVERY, STORAGE, AND HANDLING

Hardware shall be delivered to the project site in the manufacturer's original packages. Each article of hardware shall be individually packaged in the manufacturer's standard commercial carton or container, and shall be properly marked or labeled to be readily identifiable with the approved hardware schedule. Each change key shall be tagged or otherwise identified with the door for which its cylinder is intended. Where double cylinder functions are used or where it is not obvious which is the key side of a door, appropriate instructions shall be included with the lock and on the hardware schedule. Manufacturer's printed installation instructions, fasteners, and special tools shall be included in each package.

1.4 SPECIAL TOOLS

Special tools, such as those supplied by the manufacturer, unique wrenches, and dogging keys, shall be provided as required to adjust hardware items.

1.5 HARDWARE FOR FIRE DOORS

Hardware shall conform to the requirements of NFPA 80 and NFPA 101.

PART 2 PRODUCTS

2.1 GENERAL HARDWARE REQUIREMENTS

Hardware shall conform to the requirements specified herein.

2.2 TEMPLATES

Requirements for hardware to be mounted on metal doors or metal frames shall be coordinated between hardware manufacturer and door or frame manufacturer by use of templates and other information to establish location, reinforcement required, size of holes, and similar details.

Templates of hinges shall conform to BHMA A156.7.

2.3 HINGES

Hinges shall conform to BHMA A156.1. Hinges used on metal doors and frames shall also conform to BHMA A156.7. Except as otherwise specified, hinge sizes shall conform to the hinge manufacturer's printed recommendations.

2.4 LOCKS AND LATCHES

To the maximum extent possible, locksets, latchsets and deadlocks shall be the products of a single manufacturer. Lock and latch set trim (knobs, lever handles, roses and escutcheons) shall be of a simple design in accordance with manufacturer's standard practice. Knob diameter shall be 54 to 57 mm. (2-1/8 to 2-1/4 inches.)

2.4.1 Mortise Lock and Latchsets

Mortise lock, latchsets, and strikes shall be series 1000 and shall conform to BHMA A156.13, operational Grade 1. Mortise type locks and latches for doors 44 mm (1-3/4 inches) thick and over shall have adjustable bevel fronts or otherwise conform to the shape of the door. Mortise locks shall have armored fronts.

2.4.2 Omitted

2.4.3 Omitted

2.4.4 Lock Cylinders (Mortise, Rim and Bored)

Lock cylinders shall comply with BHMA A156.5 and shall be provided for all locksets. Lock cylinder shall have not less than six pins. Cylinders shall have key removable type cores. Construction interchangeable cores shall be provided. Disassembly of knob or lockset shall not be required to remove core from lockset. All locksets, exit devices, and padlocks shall accept same interchangeable cores.

2.4.5 Omitted

2.4.6 Omitted

2.4.7 Omitted

2.4.8 Lock Trim

Lock trim shall be cast, forged, or heavy wrought construction of commercial plain design. In addition to meeting the test requirement of BHMA A156.2 or BHMA A156.13, knobs, lever handles, roses, and escutcheons shall be 1.27 mm (0.050 inch) thick, if unreinforced. If reinforced, the outer shell shall be 0.89 mm (0.035 inch) thick and the combined thickness shall be 1.78 mm (0.070 inch) except that knob shanks shall be 1.52 mm (0.060 inch) thick.

2.5 OMITTED.

2.5.1 Omitted

2.5.2 Omitted

2.5.3 Omitted

2.6 KEYING

Locks shall be keyed in sets or subsets as scheduled. Locks shall be furnished with the manufacturer's standard construction key system. Change keys for locks shall be stamped with change number and the inscription "U.S. Property - Do Not Duplicate." Permanent keys shall be sent by the lock manufacturer directly to the Contracting

Officer by registered mail or other approved means. Construction keys shall be obtained in quantities as noted below.

Keys shall be supplied as follows:

Construction Cores for exterior doors: 4 keys each lock

Locks: 4 change keys each lock.

Master keys: 3 keys

2.7 DOOR CLOSING DEVICES

Door closing devices shall conform to BHMA A156.4, Grade 1. Closing devices shall be products of one manufacturer for each type specified.

2.7.1 Surface Type Closers

Surface type closers shall be Grade 1, C02000 Full Cover with options PT-4H, Size 1 or 2 through Size 6, and PT-4D with back check position valve. Except as otherwise specified, sizes shall conform to the manufacturer's published recommendations. Closers for outswinging exterior doors shall have parallel arms or shall be top jamb mounted. Closers for doors close to a wall shall be of narrow projection so as not to strike the wall at the 90-degree open position.

2.8 OMITTED

2.9 OMITTED

2.10 ARCHITECTURAL DOOR TRIM

Architectural door trim shall conform to BHMA A156.6.

2.10.1 Door Protection Plates

2.10.1.1 Omitted

2.10.1.2 Kick Plates

Kick plates shall be Category J100 stainless steel. Width of plates shall be 50 mm (2 inches) less than door width for single doors and 25 mm (1 inch) less for pairs of doors. Height shall be 250 mm, (10 inches,) except where the bottom rail is less than 250 mm (10 inches) the plate shall extend to within 13 mm (1/2 inch) of the panel mold or glass bead.

2.11 AUXILIARY HARDWARE

Auxiliary hardware, consisting of door stops, shall conform to BHMA A156.16.

2.12 MISCELLANEOUS

2.12.1 Omitted

2.12.2 Metal Thresholds

Thresholds shall conform to BHMA A156.21. Thresholds for exterior doors shall be extruded aluminum of the type indicated and shall provide proper clearance and an effective seal with specified weather stripping. Air leakage rate of weatherstripping shall not exceed 0.775 l/s per lineal meter (0.5 cubic feet per minute per lineal foot) of crack when tested in accordance with ASTM E 283 at standard test conditions.

2.12.3 Omitted

2.12.4 Aluminum Housed Type Weatherseals

Weatherseals shall consist of extruded aluminum retainers not less than 1.78 mm (0.07 inch) wall thickness with vinyl, neoprene, silicone rubber, polyurethane or vinyl brush inserts. Weatherseal material shall be of an industrial/commercial grade. Seals shall remain functional through all weather and temperature conditions. Air leakage rate of weatherstripping shall not exceed 0.775 L/s per lineal meter (0.5 cubic feet per minute per lineal foot) of crack when tested in accordance with ASTM E 283 at standard test conditions.

2.13 FASTENINGS

Fastenings of proper type, size, quantity, and finish shall be supplied with each article of hardware. Machine screws and expansion shields shall be used for attaching hardware to concrete or masonry. Fastenings exposed to the weather in the finished work shall be of brass, bronze, or stainless steel. Sex bolts, through bolts, or machine screws and grommet nuts, where used on reverse-bevel exterior doors equipped with half-surface or full-surface hinges, shall employ one-way screws or other approved tamperproof screws. Screws for the jamb leaf of half-mortise and full-surface hinges attached to structural steel frames shall be one-way or other approved tamperproof type.

2.14 FINISHES

Unless otherwise specified, finishes shall conform to those identified in BHMA A156.18 and shall be 630, satin stainless. Where painting of primed surfaces is required, painting is specified in Section 09900 PAINTING, GENERAL.

2.15 Key Control Storage System

Key control storage system shall conform to BHMA A156.5, grade 1, wall mounted system, minimum 25 hook capacity with expansion, and shall be properly labeled for key identification.

PART 3 EXECUTION

3.1 APPLICATION

Hardware shall be located in accordance with DHI-04 and DHI-05. When approved, slight variations in locations or dimensions will be permitted. Application shall be in accordance with DHI-02 or DHI A115-W. Door control devices for exterior doors such as closers and holders, shall normally attach to doors with thru bolts and nuts or sex bolts.

3.1.1 Hardware for Fire Doors

Hardware for labeled fire doors shall be installed in accordance with requirements of NFPA 80 and NFPA 105.

3.1.2 Door-Closing Devices

Door-closing devices shall be installed and adjusted in accordance with the templates and printed instructions supplied by the manufacturer of the devices. Insofar as practicable, doors opening to or from halls and corridors shall have the closer mounted on the room side of the door.

3.1.3 Omitted

3.1.4 Kick Plates

Kick plates shall be installed on the push side of single-acting doors.

3.1.5 Omitted

3.1.6 Thresholds

Thresholds shall be secured with a minimum of 3 fasteners per single door width and 6 fasteners per double door width with a maximum spacing of 300 mm. (12 inches.) Exterior thresholds shall be installed in a bed of sealant with expansion anchors and stainless steel screws, except that bronze or anodized bronze thresholds shall be installed with expansion anchors with brass screws. Minimum screw size shall be No. 10 length, dependent on job conditions, with a minimum of 19 mm (3/4 inch) thread engagement into the floor or anchoring device used.

3.1.7 Rain Drips

Door sill rain drips shall align with the bottom edge of the door. Overhead rain drips shall align with bottom edge of door frame rabbet. Drips shall be set in sealant and fastened with stainless steel screws.

3.1.8 Weatherseals

Weatherseals shall be snug to door face and fastened in place with color matched metal screws after door and frames have been finish painted. Screw spacing shall be as recommended by manufacturer.

3.1.9 Gasketing

Gasketing shall be installed at the inside edge of the hinge and head and latch sides of door frame. Frames shall be toleranced for a 3 mm (1/8 inch) clearance between door and frame. Frames shall be treated with tape primer prior to installation.

3.2 Key Control Storage System

Mount on wall where directed by the Contracting Officer. All keys shall be tagged and identified for storage.

3.3 HARDWARE SETS

DOOR HARDWARE SCHEDULE

SET NO. 1

Main Entrance

Door No. 1 (3'-0" X 7'-0" Glass Storefront Entrance door with 3'-0" X 7'-0" side window)

Door shall receive:

Pivots: 1 PR Standard storefront entrance door offset top and bottom pivots for doors 7'-0" high
(Example: Kawneer Co. Inc.)

Exit Device: 1 EACH ANSI A156.3, Type 6 Concealed vertical rod (Example: Von Duprin Type 33)

Pulls : 1 EACH Architectural grade (Example: Kawneer "Architects Classic" style)

Overhead Closer: 1 EACH Standard storefront entrance door closer (Example: Norton 1605 standard Kawneer closer)

Weatherstripping: 1 set Standard for thermal storefront entrance Threshold: 1 3'-0" ANSI A156.21 J32130

SET NO. 2

Exit Doors

Door No. 2 (3'-0" X 7'-0") Warehouse

Door No. 3 (3'-0" X 7'-0") Warehouse

Door No. 18 (3'-0" X 7'-0") Hall, Room 111

Each door shall receive:

Hinges: 1 1/2 PR EACH	ANSI A156.1 A5111
Mortise Lock: 1 EACH	ANSI A156.13 Series 1000 F05, "classroom function" Grade 1
Overhead Closer: 1 EACH	ANSI A156.4 C02021
Kickplates: 1 EACH	ANSI A156.6 J102
Weatherstripping: 1 set	As previously specified.
Silencers 1 set	ANSI A156.16 L03011
Raindrips: 1 EACH	Pemko 346C or approved equal
Threshold: 1 3'-0"	ANSI A156.21 J32123

SET NO. 3

Mechanical Room

Door No. 04 (Pair 3'-0" X 7'-0")

Hinges: 1 1/2 pair EACH (4 1/2" X 4 1/2") ANSI A156.1 A5111

Bored Lock: 1 (Active Leaf) ANSI A156.2 Series 4000 F76, Grade 1 (Locking requirement Shall be accomplished with combination lock, see below.) Combination Lock (Active Leaf) Push Button Type - Locks automatically when door closes and requires correct combination to reopen from the outside. Can always be opened from the inside by turning lever. The thumb slide on inside housing is used to hold the latch in a retracted position to keep the lock open when desired. Example: Simplex automatic spring latch, Model NL Nightlatch model, 200 series, or approved equal.

Overhead Holder: 1(Each Leaf)	ANSI A156.8 C03511
Flush Slide Bolt: 2 (Inactive Leaf)	ANSI A156.16 L04201
Threshold: 1- 6'-0"	ANSI A156.21 J35100
Tee Astragal	Bronze anodized aluminum

SET NO. 4

Offices

Door No. 5 (3'-0" X 6'-8")

Door No. 6 (3'-0" X 6'-8")

Door No. 7 (3'-0" X 6'-8")

Door No. 8 (3'-0" X 6'-8")

Door No. 9 (3'-0" X 6'-8")

Door No. 10 (3'-0" X 6'-8")

Door No. 11 (3'-0" X 6'-8")

Each door shall receive:

Hinges: 1 1/2 Pair EACH (4 1/2" X 4 1/2") ANSI A156.1 A5131
Bored Lock 1 EACH ANSI A156.2 F82, Grade 1

Overhead Closer: 1 EACH	ANSI A156.4 C02021
Kickplates: 1 EACH	ANSI A156.6 J102
Door Stop: 1 EACH.	ANSI A156.16 L02101, Contractor shall provide solid wood blocking for attaching.
Silencers 1 set	ANSI A156.16 L03011
Threshold 1 EACH	3/8" x 2 1/2" Carpet-Type (Example: Pemko

SET NO. 5

Door No. 12 Breakroom (3'-0" X 6'-8" ¾ hour door assembly)
 Door No. 14 Shower Room (3'-0" X 6'-8" ¾ hour door assembly)
 Door No. 16 Haz Waste Office (3'-0" X 6'-8" ¾ hour door assembly)

Hinges: 1 ½ Pair EACH (4 1/2" X 4 1/2")	ANSI A156.1 A5111
Bored Lock 1 EACH	ANSI A156.2 F82, Grade 1
Overhead Closer: 1 EACH	ANSI A156.4 C02011
Door Seal	Smoke/Fire Sponge Silicone Door Seal
	Clear Aluminum (Example: Pemko 315CR)
Kickplates: 1 EACH	ANSI A156.6 J102
Threshold: 1 EACH	Smoke/Fire Sponge Silicone Door Seal
	Aluminum (Example: Pemko 2001AS)
	174C)

SET NO. 6
 Restroom

Door No. 13 (3'-0" X 6'-8")

Each door shall receive:

Hinges: 1 ½ Pair EACH (4 1/2" X 4 1/2")	ANSI A156.1 A5111
Bored Lock 1 EACH	ANSI A156.2 F75, Grade 1
Overhead Closer: 1 EACH	ANSI A156.4 C02021
Kickplates: 1 EACH	ANSI A156.6 J102
Silencers 1 set	ANSI A156.16 L03011

SET NO. 7
 Door No. 15 (2'-8" X 6'-8") Communications Closet (LAN/TEL)
 Door No. 17 (2'-0" X 6'-8") Pantry

Hinges: 1 ½ Pair EACH (4 1/2" X 4 1/2")	ANSI A156.1 A5111
Bored Lock 1 EACH	ANSI A156.2 F81, Grade 1

(END OF SECTION)

SECTION 08810
GLASS AND GLAZING
PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 509	(1991) Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM C 669	(1975; R 1989) Glazing Compounds for Back Bedding and Face Glazing of Metal Sash
ASTM C 864	(1990) Dense Elastomeric Seal Gaskets, Setting Blocks, and Spacers
ASTM C 920	(1987) Elastomeric Joint Sealants
ASTM C 1036	(1991) Flat Glass
ASTM C 1048	(1988) Heat-Treated Flat Glass—Kind HS, Kind FT Coated and Uncoated Glass
ASTM D 395	(1989) Rubber Property - Compression Set
ASTM E 152	(1981a) Fire Tests of Door Assemblies
ASTM E 163	(1984) Fire Tests of Window Assemblies
ASTM E 773	(1988) Seal Durability of Sealed Insulating Glass Units
ASTM E 774	(1988) Sealed Insulating Glass Units

FEDERAL SPECIFICATIONS (FS)

FS DD-M-411	(Rev C) Mirrors, Glass
-------------	------------------------

FLAT GLASS MARKETING ASSOCIATION (FGMA)

FGMA-01	(1990) Glazing Manual
---------	-----------------------

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	(1992) Fire Doors and Windows
---------	-------------------------------

1.2 SUBMITTALS

None

1.3 SYSTEM DESCRIPTION

Glazing systems shall be fabricated and installed watertight and airtight to withstand thermal movement and wind loading without glass breakage, gasket failure, deterioration of glazing accessories, and defects in the work.

1.4 OMITTED

1.5 OMITTED

1.6 WARRANTY

1.6.1 Insulating Glass

Manufacturer shall warrant the insulating glass to be free of fogging or film formation on the internal glass surfaces caused by failure of the hermetic seal for a period of 10 years from Date of Substantial Completion. Warranty shall be signed by the manufacturer.

PART 2 PRODUCTS

2.1 FLAT GLASS

2.1.1 Transparent Glass

Annealed glass shall be Type I transparent flat type, Class 1 - clear, Quality, q5 - glazing B and shall be provided for openings not indicated or specified otherwise.

2.2 TEMPERED GLASS

Glass shall conform to ASTM C 1048, Kind FT, Condition A, Type I, Class 1, 1/4" Thick.

2.3 INSULATING GLASS

Insulating glass shall be Class A preassembled units of dual-seal construction consisting of lites of glass separated by an aluminum spacer and dehydrated space conforming to ASTM E 773 and ASTM E 774. Aluminum spacer shall be roll-formed, with bent or tightly soldered joints to completely seal the spacer periphery and eliminate moisture and hydrocarbon vapor transmission into airspace through the corners. Primary seal shall be compressed polyisobutylene and the secondary seal shall be a specially formulated silicone. Glass types shall be as follows:

2.3.1 Low-E Insulating Glass

Interior and exterior glass panes for Low-E insulating units shall be Type I annealed flat glass, Class 2-tinted with anti-reflective low-emissivity coating on No. 2 surface (inside surface of exterior pane), Quality q3 - glazing select, conforming to ASTM C 1036. Glass performance shall be U-Value/Winter Nighttime 1.09, shading coefficient .73. Color shall be bronze.

2.4 OMITTED

2.5 OMITTED

2.6 WIRE GLASS

Wired glass shall be Type II flat type, Class 3 - tinted, light-reducing, Quality q8 - glazing, Form 1 - wired and polished both sides, conforming to ASTM C 1036. Wire mesh shall be polished stainless steel Mesh 1 - diamond. Wired glass for fire-rated windows shall bear an identifying UL label or the label of a nationally recognized testing agency, and shall be rated for 45 minutes when tested in accordance with ASTM E 163. Wired glass for fire-rated doors shall be tested as part of a door assembly in accordance with ASTM E 152.

2.8 MIRRORS

2.8.1 Glass Mirrors (Restroom)

Glass for mirrors shall be Type I transparent flat type, Class 1-clear, Glazing Quality q1 6.4 mm (1/4 inch) thick conforming to ASTM C 1036. Glass color shall be clear. Glass shall be coated with silver coating, copper protective coating, and mirror backing paint conforming to FS DD-M-411. Silver coating shall be highly adhesive pure silver coating of a thickness which shall provide reflectivity of 83 percent or more of incident light when viewed through 6.4 mm (1/4 inch) thick glass, free of pinholes or other defects. Copper protective coating shall be pure bright reflective copper, homogeneous without sludge, pinholes or other defects, and shall be of proper thickness to prevent "adhesion pull" by mirror backing paint. Mirror backing paint shall consist of two coats of special scratch and abrasion-resistant paint applied, and shall be baked in uniform thickness to provide a protection for silver and copper coatings, which will permit normal cutting and edge fabrication.

2.8.2 Mirror Accessories

2.8.2.1 Restroom Mirror Frames

Mirrors shall be provided with mirror frames (J-mold channels) fabricated of one-piece roll-formed Type 304 stainless steel with No. 4 brushed satin finish and concealed fasteners which will keep mirrors snug to wall. Frames shall be 31.8 x 6.4 x 6.4 mm (1-1/4 x 1/4 x 1/4 inch) continuous at top and bottom of mirrors. Concealed fasteners of type to suit wall construction material shall be provided with mirror frames.

2.10 GLAZING ACCESSORIES

2.10.1 Preformed Tape

Preformed tape shall be elastomeric rubber extruded into a ribbon of a width and thickness suitable for specific application. Tape shall be of type which will remain resilient, have excellent adhesion, and be chemically compatible to glass, metal, or wood.

2.10.2 Sealant

Sealant shall be elastomeric conforming to ASTM C 920, Type S or M, Grade NS, Class 12.5, Use G, of type chemically compatible with setting blocks, preformed sealing tape and sealants used in manufacturing insulating glass.

2.10.3 Glazing Gaskets

Glazing gaskets shall be extruded with continuous integral locking projection designed to engage into metal glass holding members to provide a watertight seal during dynamic loading, building movements and thermal movements. Glazing gaskets for a single glazed opening shall be continuous one-piece units with factory-fabricated injection-molded corners free of flashing and burrs. Glazing gaskets shall be in lengths or units recommended by manufacturer to ensure against pull-back at corners. Glazing gasket profiles shall be as indicated on drawings.

2.10.3.1 Fixed Glazing Gaskets

Fixed glazing gaskets shall be closed-cell (sponge) smooth extruded compression gaskets of cured elastomeric virgin neoprene compounds conforming to ASTM C 509, Type 2, Option 1.

2.10.3.2 Wedge Glazing Gaskets

Wedge glazing gaskets shall be high-quality extrusions of cured elastomeric virgin neoprene compounds, ozone resistant, conforming to ASTM C 864, Option 1, Shore A durometer between 65 and 75.

2.10.3.3 Aluminum Framing Glazing Gaskets

Glazing gaskets for aluminum framing shall be permanent, elastic, non-shrinking, non-migrating, watertight and weathertight.

2.10.4 Putty and Glazing Compound

Glazing compound shall conform to ASTM C 669 for face-glazing metal sash. Putty and glazing compounds shall not be used with insulating glass or laminated glass.

2.10.5 Setting and Edge Blocking

Neoprene setting blocks shall be dense extruded type conforming to ASTM D 395, Method B, Shore A durometer between 70 and 90. Edge blocking shall be Shore A durometer of 50 (+ or - 5). Silicone setting blocks shall be required when blocks are in contact with silicone sealant. Profiles, lengths and locations shall be as required and recommended in writing by glass manufacturer.

PART 3 EXECUTION

3.1 PREPARATION

Openings and framing systems scheduled to receive glass shall be examined for compliance with approved shop drawings, FGMA-01 and glass manufacturer's recommendations including size, squareness, offsets at corners, presence and function of weep system, face and edge clearance requirements and effective sealing between joints of glass-framing members. Detrimental materials shall be removed from glazing rabbet and glass surfaces and wiped dry with solvent. Glazing surfaces shall be dry and free of frost.

3.2 INSTALLATION

Glass and glazing work shall be performed in accordance with approved shop drawings, FGMA-01, glass manufacturer's instructions and warranty requirements. Glass shall be installed with factory labels intact and removed only when instructed. Wired glass shall be installed in accordance with NFPA 80. Edges and corners shall not be ground, nipped or cut after leaving factory. Springing, forcing or twisting of units during installation will not be permitted.

3.3 CLEANING

Upon completion of project, outside surfaces of glass shall be washed clean and the inside surfaces of glass shall be washed and polished in accordance with glass manufacturer's recommendations.

3.4 PROTECTION

Glass work shall be protected immediately after installation. Glazed openings shall be identified with suitable warning tapes, cloth or paper flags, attached with non-staining adhesives. Glass units, which are broken, chipped, cracked, abraded, or otherwise damaged during construction activities, shall be removed and replaced with new units.

(END OF SECTION)

SECTION 09250
GYPSUM WALLBOARD
PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 36	(1994) Gypsum Wallboard
ASTM C 475	(1993) Joint Compound and Joint Tape for Finishing Gypsum Board
ASTM C 514	(1994) Nails for the Application of Gypsum Board
ASTM C 557	(1993a) Adhesive for Fastening Gypsum Wallboard to Wood Framing
ASTM C 630	(1993) Water-Resistant Gypsum Backing Board
ASTM C 645	(1994) Non-Load (Axial) Bearing Steel Studs, runners (Track), and rigid furring channels for Screw Application of Gypsum Board
ASTM C 840	(1994) Application and Finishing of Gypsum Board
ASTM C 1002	(1993) Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases

1.2 DELIVERY, STORAGE AND HANDLING

Materials shall be delivered in original containers bearing the name of manufacturer, contents, and brand name. Materials shall be stored in accordance with manufacturer's printed instructions.

1.3 ENVIRONMENTAL CONDITIONS

Environmental conditions for application and finishing of gypsum board shall be in accordance with ASTM C 840.

PART 2 MATERIALS

2.1 NON-LOADBEARING STUD WALLS

2.1.1 Studs

Studs for non-loadbearing walls shall conform to ASTM C 645. Studs shall be 20 gauge steel, C-shaped, punched web for utility access, G60 hot-dip galvanized, or truss-designed studs fabricated of 1.519mm thick (16 gauge) steel angles with a single No. 7 gauge rod forming an open-web truss.

2.1.2 Runner Tracks

Floor and ceiling runner tracks shall conform to ASTM C 645. Tracks shall be, U-shaped with minimum 22 mm (7/8 inch) flanges, unpunched web, gauge to match studs, G60 hot-dip galvanized.

2.2 GYPSUM BOARD

Gypsum board shall have square-cut ends, tapered or beveled edges and shall be maximum possible length.

2.2.1 Standard Gypsum Board

Regular gypsum board shall conform to ASTM C 36, and shall be 1200 mm (48 inches) wide.

2.2.2 Fire-Rated Gypsum Board

Fire-rated gypsum board shall conform to ASTM C 36, and shall be Type X, 1200 mm (48 inches) wide. Fire-rated gypsum board shall be used where indicated on the drawings.

2.2.3 Water-Resistant Gypsum Board

Water-resistant gypsum board shall conform to ASTM C 630, Type X, and shall be 1200-mm (48-inch) width. Water-resistant gypsum board shall be used in restrooms, break rooms, kitchens, and any other areas subject to water.

2.3 ACCESSORIES

2.3.1 Taping and Embedding Compound

Taping and embedding compound shall conform to ASTM C 475.

2.3.2 Finishing or Topping Compound

Finishing or topping compound shall conform to ASTM C 475.

2.3.3 All-Purpose Compound

All-purpose compound shall be compatible with tape and substrate.

2.3.4 Joint Tape

Joint tape shall conform to ASTM C 475 and shall be as recommended by gypsum board manufacturer.

2.3.5 Nails

Nails shall conform to ASTM C 514.

2.3.6 Screws

Screws shall conform to ASTM C 1002. Screws shall be, Type S for wood or light-gauge steel framing.

2.3.7 Adhesives

Adhesives shall conform to ASTM C 557.

2.3.8 Access Doors

Where required and applicable, provide drywall - type metal access doors in restrooms or other areas where water hammer arresters, valves or other plumbing is required to be accessed. Access doors and frames shall be especially fabricated for drywall applications, prefinished, and equipped with cam-type lock.

PART 3 EXECUTION

3.1 APPLICATION OF GYPSUM BOARD

Gypsum board shall be installed in accordance with ASTM C 840 and as specified.

3.2 TAPING AND FINISHING

Gypsum board taping and finishing shall be performed in accordance with ASTM C 840.

3.3 PATCHING

Surface defects and damage shall be corrected as required to leave gypsum board ready to receive finish as specified.

(END OF SECTION)

SECTION 09510**ACOUSTICAL CEILINGS****PART 1 GENERAL****1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- | | |
|-------------|--|
| ASTM C 635 | (1994) Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings |
| ASTM C 636 | (1992) Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels |
| ASTM E 1264 | (1990) Standard Classification for Acoustical Ceiling Products ASTM E 1414 (1991a) Standard Test for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum. |

1.2 GENERAL REQUIREMENTS

Acoustical treatment shall consist of sound controlling units mechanically mounted on a ceiling suspension system. The unit size, texture, finish, and color shall be as specified.

1.3 SUBMITTALS

The following shall be submitted:

Data

Acoustical Ceiling System;

Manufacturer's descriptive data, catalog cuts, and installation instructions.

1.4 DELIVERY AND STORAGE

Materials shall be delivered to the site in the manufacturer's original unopened containers with brand name and type clearly marked. Materials shall be carefully handled and stored in dry, watertight enclosures. Immediately before installation, acoustical units shall be stored for not less than 24 hours at the same temperature and relative humidity as the space where they will be installed to assure temperature and moisture conditions.

1.5 ENVIRONMENTAL REQUIREMENTS

A uniform temperature of not less than 16 degrees C (60 degrees F) nor more than 27 degrees C (80 degrees F) and a relative humidity of not more than 70 percent shall be maintained before, during, and after installation of acoustical units.

1.6 SCHEDULING

Interior finish work such as plastering, concrete and terrazzo work shall be complete and dry before installation. Mechanical, electrical, and other work above the ceiling line shall be completed and heating, ventilating, and air conditioning systems shall be installed and operating in order to maintain temperature and humidity requirements.

1.7 EXTRA MATERIALS

Spare tiles of each type shall be furnished at the rate of 10 tiles for each 1000 tiles installed. Tiles shall be from the same lot as those installed.

PART 2 PRODUCTS

2.1 ACOUSTICAL UNITS

Acoustical units shall conform to ASTM E 1264, Class A, and the following requirements:

2.1.1 Units for Exposed-Grid System

Units for Exposed-Grid System, humidity resistant panels (RH 90), scuff resistant

Type III, Form 2, Class 25

Minimum NRC: 0.60 when tested on mounting No. E-400

Nominal size: 24 by 24 inches.

Edge detail: SQ

Finish: Factory-applied finish - White

Minimum LR coefficient: 1.0

Minimum CAC: 35-39.

2.2 SUSPENSION SYSTEM

Suspension system shall be standard exposed-grid standard width flange, for moisture-resistant panels, and shall conform to ASTM C 635 for intermediate-duty systems. Surfaces exposed to view shall be aluminum or steel with a factory-applied white baked-enamel finish. For standard grid, wall molding shall have a flange of not less than 23 mm (15/16 inch) and shall be provided with outside corner caps. Inside corner caps shall be provided where, due to the configuration of the installation, they are needed to produce a workmanlike appearance.

2.3 HANGERS

Hangers shall be galvanized steel wire. Hangers and attachment shall support a minimum 1330 N (300 pound) ultimate vertical load without failure of supporting material or attachment.

2.4 OMITTED

2.5 OMITTED

2.6 FINISHES

Acoustical units and suspension system members shall have manufacturer's standard textures, patterns and finishes. Ceiling suspension system components shall be treated to inhibit corrosion.

2.7 OMITTED

2.8 CEILING ATTENUATION CLASS

Ceiling attenuation class (CAC) range of acoustical units, where required, shall be determined in accordance with ASTM E 1414.

PART 3 EXECUTION

3.1 INSTALLATION

Acoustical work shall be provided complete with necessary fastenings, clips, and other accessories required for a complete installation. Mechanical fastenings shall not be exposed in the finished work. Hangers shall be laid out for each individual room or space. Hangers shall be placed to support framing around beams, ducts, columns, grilles, and other penetrations through ceilings. Main runners and carrying channels shall be kept clear of abutting walls and partitions. At least two main runners shall be provided for each ceiling span. Wherever required to bypass an object with the hanger wires, a subsuspension system shall be installed, so that all hanger wires will be plumb.

3.1.1 Suspension System

Suspension system shall be installed in accordance with ASTM C 636 and as specified herein. There shall be no hanger wires or other loads suspended from underside of steel decking.

3.1.1.1 Plumb Hangers

Hangers shall be plumb and shall not press against insulation covering ducts and pipes.

3.1.1.2 Splayed Hangers

Where hangers must be splayed (sloped or slanted) around obstructions, the resulting horizontal force shall be offset by bracing, countersplaying, or other acceptable means.

3.1.2 Wall Molding

Wall molding shall be provided where ceilings abut vertical surfaces. Wall molding shall be secured not more than 75 mm (3 inches) from ends of each length and not more than 400 mm (16 inches) on centers between end fastenings. Wall molding springs shall be provided at each acoustical unit in semi-exposed or concealed systems.

3.1.3 Acoustical Units

Acoustical units shall be installed in accordance with the approved installation instructions of the manufacturer. Edges of acoustical units shall be in close contact with metal supports, with each other, and in true alignment. Acoustical units shall be arranged so that units less than one-half width are minimized. Units in exposed-grid system shall be held in place with manufacturer's standard hold-down clips, if units weigh less than 5 kg per square m (1 psf).

3.2 OMITTED

3.3 CLEANING

Following installation, dirty or discolored surfaces of acoustical units shall be cleaned and left free from defects. Units that are damaged or improperly installed shall be removed and new units provided as directed.

(END OF SECTION)

SECTION 09650**RESILIENT FLOORING****PART 1 GENERAL****1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM F 1066	(1987) Vinyl Composition Floor Tile
FS P-F-430	(Rev C; Am 1) Finish, Floor, Water-Emulsion (For Use on Light Colored Floors)
FS P-W-155	(Rev C; Int Am 1) Wax, Floor, Water-Emulsion
FS SS-W-40	(Rev A; Int Am 1; Notice 1) Wall Base: Rubber, and Vinyl Plastic

1.2 SUBMITTALS

The following shall be submitted:

Samples

Resilient Flooring and Accessories.

Samples of Manufacturer's standard colors for each type of flooring and accessory. Sample size shall be minimum 75 mm by 75 mm. (3 inches by 3 inches.)

1.3 DELIVERY AND STORAGE

Materials shall be delivered to the building site in original unopened containers, shall be stored in a clean dry area with temperature maintained above 21 degrees C (70 degrees F) for 2 days prior to installation, and shall be stacked according to manufacturer's recommendations.

1.4 ENVIRONMENTAL REQUIREMENTS

Areas to receive resilient flooring shall be maintained at a temperature above 21 degrees C (70 degrees F) for 2 days before application, during application and 2 days after application. A minimum temperature of 13 degrees C (55 degrees F) shall be maintained thereafter.

1.5 SCHEDULING

Resilient flooring application shall be scheduled after the completion of other work which would damage the finished surface of the flooring.

1.6 EXTRA MATERIALS

Extra flooring material of each color and pattern shall be furnished at the rate of 10 tiles for each 1000 tiles. Extra materials shall be from the same lot as those installed.

PART 2 PRODUCTS

2.1 VINYL-COMPOSITION TILE

Vinyl-composition tile shall conform to ASTM F 1066, through pattern tile, Composition 1, asbestos-free, and shall be 300 mm square (12 inches square) and 3.2 mm (1/8 inch) thick. Tile shall have the color and pattern uniformly distributed throughout the thickness of the tile. Flooring in any one continuous area shall be from the same lot and shall have the same shade and pattern. Color and pattern shall be as selected.

2.2 Omitted

2.3 RESILIENT BASE

Base shall conform to FS SS-W-40, Type I (rubber) or Type II (vinyl). Style A, (straight)-installed with carpet. Style B, (coved)-installed with resilient flooring. Base shall be 101.6 mm (4 inches) high and a minimum 3 mm (1/8 inch) thick. Preformed outside corners shall be furnished. Color shall be as selected.

2.4 ADHESIVE

Adhesive for flooring shall be as recommended by the flooring manufacturer.

2.5 POLISH

Polish shall conform to FS P-F-430 or FS P-W-155. A sealer approved by the manufacturer of the floor tile shall be provided.

PART 3 EXECUTION

3.1 EXAMINATION/VERIFICATION OF CONDITIONS

The Contractor shall verify that site conditions are in agreement with the design package and shall report all conditions that will prevent a proper installation. The Contractor shall not take any corrective action without written permission from the Government.

3.2 SURFACE PREPARATION

Flooring shall be in a true, level plane. Before any work under this section is begun, all defects such as low spots, high spots, and uneven surfaces shall have been corrected, and all damaged portions of concrete surface shall have been repaired as recommended by the flooring manufacturer.

3.3 INSTALLATION OF VINYL-COMPOSITION TILE

Tile flooring shall be installed with adhesive in accordance with the manufacturer's installation instructions. Tile lines and joints shall be kept square, symmetrical, tight, and even. Each floor shall be in a true, level plane. Edge width shall vary as necessary to maintain full-size tiles in the field, but no edge tile shall be less than one-half the field tile size, except where irregular shaped rooms make it impossible. Flooring shall be cut to, and fitted around, all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Edge tile shall be cut, fitted, and scribed to walls and partitions after field flooring has been applied.

3.4 INSTALLATION OF RESILIENT BASE

Wall base shall be installed with adhesive in accordance with the manufacturer's instructions. Base joints shall be tight and base shall be even with adjacent resilient flooring.

3.5 Omitted.

3.6 CLEANING AND POLISHING

Immediately upon completion of installation of tile in a room or an area, flooring and adjacent surfaces shall be cleaned to remove all surplus adhesive. No sooner than 5 days after installation, flooring shall be washed with a nonalkaline cleaning solution, and rinsed thoroughly with clear cold water. One (1) coat of sealer and three (3) coats of polish shall be applied to all tile. After each polish coat, floors shall be buffed to an even luster with an electric polishing machine.

3.7 PROTECTION

From the time of laying until acceptance, flooring shall be protected from damage. Flooring which becomes damaged, loose, broken, or curled shall be removed and replaced.

(END OF SECTION)

SECTION 09680**CARPET****PART 1 GENERAL****1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS
(AATCC)

AATCC-02 (1979; R 1986) Electrostatic Propensity of Carpets (Test Method 134)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 418 (1982) Pile Yarn Floor Covering Construction

ASTM D 1335 (1967; R 1972) Tuft Bind of Pile Floor Coverings

ASTM E 648 (1988) Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source

CARPET AND RUG INSTITUTE (CRI)

CRI-104 (1986) Installation of Textile Floorcovering Materials

CODE OF FEDERAL REGULATIONS (CFR)

CFR 16 Part 1630 (1987) Standard for the Surface Flammability of Carpet and Rugs (FF1-70)

FEDERAL SPECIFICATIONS (FS)

FS L-C-001676 (Basic; Am. 1) Cushion, Carpet and Rug, Virgin Urethane

FS ZZ-C-00811 (Rev. B) Cushion, Carpet and Rug, Cellular Rubber

FS DDD-C-0095 (Rev. A) Carpets and Rugs, Wool, Nylon, Acrylic, Modacrylic Polyester, Polypropylene

FS DDD-C-001023 (Basic; Am. 1) Cushion, Carpet and Rug (Hair Felt and Rubber Coated Jute and Animal Hair or Fiber)

1.2 SUBMITTALS

The following shall be submitted:

Samples:

- a. Carpet: Manufacturer's sample color selections for carpet proposed for use, showing quality, pattern, and color

selections.

- b. Vinyl or Aluminum Moldings: Manufacturer's standard color selections.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Physical Requirements

Carpet shall be tufted with "Tufloc Backing System", "Superloc Backing System" or other direct glue-down backing; free of visual blemishes, streaks, poorly dyed areas, and manufacturing defects. Carpet materials and treatments shall be nontoxic, reasonably nonallergenic, and free of other recognized health hazards. Carpet shall have permanent anti-microbial protection built into the fiber and shall conform to the following:

- a. Pile Surface Texture: Tufted Loop.
- b. Pile Fiber: Nylon.
- c. Pile weight: 28 ounce per square yard minimum.
- d. Pile Density: 5390 Minimum
- e. Width: 12 feet minimum useable carpet
- f. Flame Resistance: Class I
- g. Smoke: Rated less than 450 on NBS Smoke Density Test
- h. Pattern and color: As scheduled

2.1.2 Surface Texture

- a. Loop Pile

Textured surface carpet shall consist of either single-level uncut pile or textured uncut pile to create an overall nondirectional surface. Maximum differential between finished pile heights (high and low pile loops) of textured pile shall be 0.171 inch.

2.1.2.1 Pile Yarn

Yarn shall be carpet-type fiber which has never been reclaimed from any woven, tufted, knitted, or felted products. Spun yarn of at least 2-ply construction shall be provided for loop pile carpets with sufficient twist to develop adequate yarn characteristics to ensure high wearability and to minimize pilling and fuzzing of the finished carpet. Do not use undrawn fiber in spun yarn. Plied yarns shall be provided which have a twist in the opposite direction to the singles. The yarn setting method used shall be sufficient to assure permanent texture retention under normal use conditions, cleaning, and shampooing.

2.1.2.2 Pile Density and Thickness: Pile density shall be calculated as follows:

$$\text{Density} = \frac{\text{Pile weight} \times 36}{\text{Pile Thickness}}$$

A Schiefer Compressometer in accordance with ASTM D 418 shall determine pile thickness.

2.1.2.3 Backing Materials

Backing materials shall be those customarily used and accepted by the trade for the tufted carpet. Carpet shall have a special unitary back designed for direct gluedown.

2.1.2.4 Static Control

Static control shall be provided to permanently control static buildup to less than 3500 volts when tested at 20 percent relative humidity and 70 degrees F in accordance with AATCC-02.

2.1.2.5 Critical Radiant Flux

Carpet shall comply with CFR 16 Part 1630. All carpet systems shall have a minimum average critical radiant flux of 0.25 watts per square centimeter when tested in accordance with ASTM E 648.

2.1.2.6 Tuft Bind

Tuft bind shall be a minimum 20-pound average force for loop pile and 4 pounds for cut pile when tested in accordance with ASTM D 1335.

2.3 ADHESIVES

Adhesive for installation of carpet shall be waterproof, nonflammable, and as recommended by the carpet manufacturer. Seam adhesive shall be water-proof, nonflammable, and nonstaining as recommended by the carpet manufacturer.

2.4 MOLDING

Molding shall be either aluminum or vinyl. Finish shall be a prefinished, color to match carpet. Floor flange shall be a minimum 1-1/2 inches wide and face shall be a minimum 5/8-inch wide. Aluminum molding shall be a hammered surface, pinless clamp-down type, designed for the carpet being installed. Vinyl molding shall be heavy-duty and designed for the type of carpet being installed. Floor flange shall be a minimum 2 inches wide.

2.5 TAPE

Tape for seams shall be as recommended by the carpet manufacturer for the type of seam used in installation.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

Carpet shall not be installed on surfaces that are unsuitable and will prevent a proper installation. Holes, cracks, depressions, or rough areas shall be repaired using material recommended by the carpet or adhesive manufacturer. Floor shall be free of any foreign materials and swept broom clean.

3.2 INSTALLATION

Installation shall be in accordance with the manufacturer's instructions and CRI-104.

3.2.1 Carpet

Carpet shall be installed direct glue down and shall be smooth, uniform, and secure, with a minimum of seams. Side seams shall be run toward the light where practical and where such layout does not increase the number the number of seams. Breadths shall be installed parallel, with carpet pile in the same direction. Patterns shall be accurately matched. Cutouts, as at door jambs, columns and ducts shall be neatly cut and fitted securely. Seams at

doorways shall be located parallel to and centered directly under doors. Seams shall not be made perpendicular to doors or at pivot points.

3.2.2 Seams

Seams shall be uniform, unnoticeable, and treated with a seam adhesive.

3.2.3 Molding

Edges of carpet meeting hard surface flooring shall be protected with molding. Installation shall be in accordance with the molding manufacturer's instructions.

3.3 CLEANING AND PROTECTION

3.3.1 Cleaning

After installation of the carpet, debris, scraps, and other foreign matter shall be removed. Soiled spots and adhesive shall be removed from the face of the carpet with appropriate spot remover. Protruding face yarn shall be cut off and removed. Carpet shall be vacuumed clean.

3.3.2 Protection

The installed carpet shall be protected from soiling and damage with heavy, reinforced, nonstaining kraft paper or polyethylene film until removal of protective material is directed. Edges of protection shall be lapped and secured to provide a continuous cover.

(END OF SECTION)

SECTION 09900**PAINTING, GENERAL****PART 1 GENERAL****1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH-02 (1991) 1991-1992 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Indices.

THE MASTER PAINTER'S INSTITUTE (MPI)

MPI 9	Exterior Alkyd Enamel
MPI 47	Interior Alkyd, semi-gloss
MPI 50	Interior Latex Primer Sealer
MPI 74	Interior Varnish, Semi-Gloss
MPI 90	Semi-Transparent Stain
MPI 91	Wood Filler
MPI 102	Alkyd Sanding Sealer
MPI 115	Water Based Epoxy
MPI 139	High Performance Architectural Latex Gloss Level 3 (Eggshell)

FEDERAL STANDARDS (FED-STD)

FED-STD 595 (Rev B) Colors

STEEL STRUCTURES PAINTING COUNCIL(SSPC)

SSPC SP 1	(1982) Solvent Cleaning
SSPC SP 3	(1989) Power Tool Cleaning

1.2 SUBMITTALS

The following shall be submitted:

Certificates

Prior to beginning painting operations, the Contractor shall furnish the manufacturer's certification that all paints meet or exceed the applicable Federal Specification's. These certificates shall serve as proof of compliance until such time as tests are conducted in accordance with other provisions of this specification.

1.3 PACKAGING, LABELING, AND STORING

Paints shall be in sealed containers that legibly show the designated name, formula or specification number, batch number, color, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name of manufacturer. Pigmented paints shall be furnished in containers not larger than 5 gallons. Paints and thinner shall be stored in accordance with the manufacturer's written directions and as a minimum stored off the ground, under cover, with sufficient ventilation to prevent the buildup of flammable vapors and at temperatures between 40 and 95 degrees F.

1.4 QUALITY ASSURANCE PROVISIONS

1.4.1 All paints used in the work shall be subject to sampling and testing by the Government from time to time during the course of the work. Paints from which tested samples fail to meet the applicable specifications shall be removed from the job site and all painting operations with such paint shall cease until satisfactory paint is delivered to the site and Government tests indicate compliance with the applicable specifications. All Government costs associated with retesting of replacement paints for those which fail to meet the specifications shall be deducted from the contract cost.

1.4.2 Inspection

Surface preparation, applicable procedures, and material selection will be examined to determine performance with the requirements of this specification. Each separate operation shall be approved prior to initiation of subsequent operations.

1.5 ENVIRONMENTAL CONDITIONS

Unless otherwise recommended by the paint manufacturer, the ambient temperature shall be between 45 and 95 degrees F when applying coatings other than water-thinned, and epoxy, coatings. Water-thinned coatings shall be applied only when ambient temperature is between 50 and 90 degrees F.

PART 2 PRODUCTS

2.1 PAINT

The term "paint" as used herein includes enamels, paints, and other coatings, whether used as prime, intermediate, or finish coat. Paint shall conform to the respective specifications listed for use in the painting schedules at the end of this section. Additional requirements are as follows:

2.1.1 Colors and Tints

Colors and tints shall be as selected from FED STD 595 and as indicated on the drawings. The color of the under coats shall vary slightly from the next coat. Tinting of epoxy, and urethane, paints shall be done by the manufacturer.

2.1.2 Lead

Paints containing lead in excess of 0.06 percent by weight of the total nonvolatile content (calculated as lead metal) shall not be used.

2.1.3 Chromium

Paints containing zinc chromate or strontium chromate pigments shall not be used.

2.1.4 Volatile Organic Compound (VOC) Content

Paints shall comply with applicable state and local laws enacted to insure compliance with Federal Clean Air Standards. When the materials specified in the painting schedule do not meet the applicable VOC content limitations, the Contractor shall notify the Contracting Officer prior to commencing the work.

PART 3 EXECUTION

3.1 PROTECTION OF AREAS NOT TO BE PAINTED

Items not to be painted which are in contact with or adjacent to painted surfaces shall be removed or protected prior to surface preparation and painting operations. Items removed prior to painting shall be replaced when painting is completed. Following completion of painting, workmen skilled in the trades involved shall reinstall removed items. Surfaces contaminated by coating materials shall be restored to original condition.

3.2 SURFACE PREPARATION

Surfaces to be painted shall be clean and free of foreign matter before application of paint or surface treatments. Oil and grease shall be removed with clean cloths and cleaning solvents prior to mechanical cleaning. Cleaning solvents shall be of low toxicity with a flashpoint in excess of 100 degrees F. Cleaning shall be programmed so that dust and other contaminants will not fall on wet, newly painted surfaces. Exposed ferrous metals such as nail heads on or in contact with surfaces to be painted with water-thinned paints shall be spot-primed with a suitable corrosion-inhibitive primer capable of preventing flash rusting and compatible with the coating specified for the adjacent areas.

3.2.1 Wood Surfaces

Wood surfaces shall be cleaned of foreign matter. Wood surfaces adjacent to surfaces to receive water-thinned paints shall be primed and/or touched up before applying water-thinned paints. Small, dry seasoned knots shall be scraped, cleaned, and given a thin coat of knot sealer, before application of the priming coat. Pitch on large, open, unseasoned knots and all other beads or streaks of pitch shall be scraped off, or, if it is still soft, removed with mineral spirits or turpentine, and the resinous area shall be thinly coated with knot sealer. Finishing nails shall be set, and all holes and surface imperfections shall be primed. After priming, holes and imperfections in finish surfaces shall be filled with putty or plastic wood filler conforming to MPI 91, colored to match the finish coat if natural finish is required, allowed to dry, and sanded smooth. Putty or wood filler shall be compatible with subsequent coatings. Interior wood surfaces to receive stain shall be sanded. Oak and other open-grain wood to receive stain shall be given a coat of wood sealer conforming to MPI 102 not less than 8 hours before the application of stain; excess filler shall be removed and the surface sanded smooth. Moisture content of the wood shall not exceed 12 percent as measured by a moisture meter, unless otherwise authorized.

3.2.2 Ferrous Surfaces

Ferrous surfaces including those that have been shop-coated shall be solvent-cleaned. Surfaces (including previously painted) that contain loose rust, loose mill scale, and other foreign substances shall be cleaned mechanically with power tools according to SSPC SP 3. Shop-coated ferrous surfaces shall be protected from corrosion by treating and touching up corroded areas immediately upon detection.

3.2.3 Nonferrous Metallic Surfaces

Galvanized, aluminum and aluminum-alloy, and other nonferrous metal surfaces shall be solvent-cleaned in accordance with SSPC SP 1.

3.2.4 Gypsum Board Surfaces

Gypsum board surfaces shall be dry and shall have all loose dirt and dust removed by brushing with a soft brush, rubbing with a dry cloth, or vacuum cleaning prior to application of the first-coat material.

3.2.5 Mastic-Type Surfaces

Mastic-type surfaces shall be prepared by removing foreign material.

3.3 MIXING AND THINNING

When thinning is approved as necessary to suit surface, temperature, weather conditions, or application methods, paints may be thinned in accordance with the manufacturer's directions. When thinning is allowed, paints shall be thinned immediately prior to application with not more than a pint of suitable thinner per gallon. The use of thinner shall not relieve the Contractor from obtaining complete hiding, full film thickness, or a required gloss. Thinning shall not cause the paint to exceed local limits on volatile organic compounds. Paints of different manufacturers shall not be mixed.

3.3.1 Two-Component Systems

Two-component systems shall be mixed in accordance with manufacturer's instructions. Any thinning of the first coat to ensure proper penetration and sealing shall be as recommended by the manufacturer for each type of substrate.

3.4 APPLICATION

Painting practices shall comply with applicable state and local laws enacted to insure compliance with Federal Clean Air Standards. Unless otherwise specified or recommended by the paint manufacturer, paint may be applied by brush, roller, or spray, however there shall be no exterior spray painting. At the time of application, paint shall show no signs of deterioration. Uniform suspension of pigments shall be maintained during application. Each coat of paint shall be applied so dry film shall be of uniform thickness and free from runs, drops, ridges, waves, pinholes or other voids, laps, brush marks, and variations in color, texture, and finish. Hiding shall be complete. Rollers for applying paints and enamels shall be of a type designed for the coating to be applied and the surface to be coated. Special attention shall be given to insure that all edges, corners, crevices, welds, and rivets receive a film thickness equal to that of adjacent painted surfaces. Paints, except water-thinned types, shall be applied only to surfaces that are completely free of moisture as determined by sight or touch.

3.4.1 Ventilation

Adequate ventilation shall be provided during paint application. Respirators shall be worn by all persons engaged in spray painting. Affected areas shall be ventilated during paint application so that workers exposure to chemical substances shall not exceed limits as established by ACGIH-02, or as required by a more stringent applicable regulation. Interior work zones having a volume of 280 cubic meters (10,000 cubic feet) or less shall be ventilated at a minimum of 2 air exchanges per hour. Ventilation in larger work zones shall be maintained by means of mechanical exhaust. Solvent vapors shall be exhausted outdoors, away from air intakes and workers. Return air inlets in the work zone shall be temporarily sealed before start of work until the coatings have dried.

3.4.2 First Coat

The first coat on gypsum wallboard and other surfaces shall include repeated touching up of suction spots or overall application of primer or sealer to produce uniform color and gloss. Excess sealer shall be wiped off after each application. Steel doors that are glazed shall be given both coats of paint within 3 weeks of the time they are glazed, but not before the glazing material has set; paint shall overlay glass about 70 mils all around.

3.4.3 Timing

Surfaces that have been cleaned, pretreated, and otherwise prepared for painting shall be given a coat of the

specified first coat as soon as practical after such pretreatment has been completed, but prior to any deterioration of the prepared surface. Sufficient time shall elapse between successive coats to permit proper drying. This period shall be modified as necessary to suit weather conditions. Oil-based or oleoresinous solvent- type paints shall be considered dry for recoating when the paint feels firm, does not deform or feel sticky under moderate pressure of the thumb, and the application of another coat of paint does not cause the undercoat to lift or lose adhesion. Manufacturer's instructions for application, curing and drying time between coats of two-component systems shall be followed.

3.6 SURFACES TO BE PAINTED

Surfaces listed in the painting schedules at the end of this section shall be painted as scheduled.

3.7 CLEANING

Cloths, cotton waste and other debris that might constitute a fire hazard shall be placed in closed metal containers and removed at the end of each day. Upon completion of the work, staging, scaffolding, and containers shall be removed from the site or destroyed in an approved manner. Paint and other deposits on adjacent surfaces shall be removed and the entire job left clean and acceptable.

3.8 PAINTING SCHEDULE

The following painting schedule identifies the surfaces to be painted and prescribe the paint to be used and the number of coats of paint to be applied.

PAINTING SCHEDULE

Surface	First Coat	Second Coat	Third Coat
Gypsum Board, (Breakroom, Restrooms)	Manufacturer's Recommended Primer/Sealer	MPI 115	MPI 115
Gypsum Board (All other Walls)	MPI 50	MPI 139	MPI 139
Built-In Wood Shelving and Cabinets to receive stain	MPI 90	MPI 74	MPI 74
Metal (Doors and Frames)	Factory Primed	MPI 47	MPI 47
Metal: (Louvers, Grilles, Other ferrous metal Including exposed Structural and framing Steel components)	Factory Primed	MPI 47	MPI 47

Exterior Metal (Doors, Frames, Louvers)	Factory Primed	MPI 9	MPI 9
(END OF SECTION)			

SECTION 10430**SIGNAGE****PART 1 GENERAL****1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ALUMINUM ASSOCIATION (AA)

AA DAF-45 (1980) Designation System for Aluminum Finishes

ASTM B 26 (1995) Aluminum Alloy Sand Castings

ASTM B 108 (1995) Aluminum Alloy Permanent Mold Castings

**NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS
(NAAMM)**

NAAMM AMP 505 (1988) Metal Finishes Manual for Architectural and Metal Products;
Section: Applied Coatings

1.2 GENERAL

Signage shall be of the size and type indicated below and shall conform to the requirements specified herein. Signs shall be complete with lettering, framing as detailed, and related components for a complete installation. Materials shall be the standard product of a manufacturer regularly engaged in the manufacture of the products.

1.3 SUBMITTALS

The following shall be submitted:

Data

Exterior and Interior Signs;

Manufacturer's descriptive data, catalog cuts, and installation instructions.

1.4 DELIVERY AND STORAGE

Materials shall be wrapped for shipment and storage, delivered to the jobsite in manufacturer's original packaging, and stored in a clean, dry area.

PART 2 PRODUCTS**2.1 COLOR**

Color of products shall be as selected from manufacturer's standards.

2.2 ALUMINUM ALLOY PRODUCTS

Aluminum alloy products shall conform to ASTM B 26 or ASTM B 108 for castings.

2.2.1 Anodic Coating

Anodized bronze finish shall conform to AA DAF-45 as follows:

- a. Integrated color anodized designation AA-M10-C22-A32, Architectural Class 0.010 to 0.018 mm. (0.4 to 0.7 mil.)

OR

- b. Electrolytically deposited color - anodized designation AA-M10-C22-A34, Architectural Class II 0.010 to 0.018 mm. (0.4 to 0.7 mil.)

2.3 ORGANIC COATING

Surfaces shall be cleaned, primed, and given a two-component acrylic polyurethane finish in accordance with NAAMM AMP 505 with total dry film thickness not less than 0.030 mm. (1.2 mils.)

2.4 OMITTED

2.5 CAST METAL

Components shall be fabricated with sharp corners, flat faces, and accurate profiles. Burrs and rough spots shall be removed and polished. Faces shall be finished to a uniform high luster.

2.5.1 Cast Aluminum

Cast aluminum shall be in accordance with ASTM B 108.

2.6 PLAQUE SIGNS

Plaque signs shall be a modular type signage system. Signs shall be fabricated of Type ES laminated thermosetting plastic suitable for engraving. Provide signs where shown on the drawings.

2.6.1 Standard Modular Plaque Signs

Plaque signs shall consist of matte finish laminated thermosetting Type ES plastic, 1/8" thickness and size as shown. Frames shall be molded acrylic. Corners of signs shall be squared.

2.6.3 Type of Mounting For Plaque Signs

Surface mounted signs shall be provided with 1.6 mm (1/16 inch) thick vinyl foam tape or countersunk mounting holes in plaques and mounting screws.

2.7 DIMENSIONAL BUILDING LETTERS

2.7.1 Fabrication

Letters and numbers shall be fabricated from cast aluminum. Letters and numbers shall be cleaned by chemical etching or cleaned ultrasonically in a special degreasing bath. Letters and numbers shall be packaged for protection until installation.

2.7.2 Typeface

Typeface shall be helvetica medium. Text shall read as follows:

“ENVIRONMENTAL BRANCH”

“615” (The building number shall be provided in two different locations)

2.7.3 Size

Letter size shall be 12” tall.

Number size shall be 8” tall.

2.7.4 Finish

Anodized finish shall be provided.

2.7.5 Mounting

Threaded studs, of number and size as recommended by manufacturer, shall be secured to metal wall panels for concealed anchorage. Letters which project from the building line shall have stud spacer sleeves. Letters, studs, and sleeves shall be of the same material. Templates for mounting shall be supplied. Mount letters on metal wall panels where indicated.

PART 3 EXECUTION

3.1 INSTALLATION

Signs shall be installed in accordance with approved manufacturer's instructions at locations directed and as shown on the drawings. Signs shall be installed plumb and true at mounting heights indicated, and by method shown or specified. Signs mounted on other surfaces shall not be installed until finishes on such surfaces have been completed.

3.1.1 Anchorage

Anchorage shall be in accordance with approved manufacturer's instructions. Anchorage not otherwise specified or indicated shall include slotted inserts and power-driven fasteners or machine carriage bolts for attachment to metal wall panels or metal doors.

3.1.2 Protection and Cleaning

The work shall be protected against damage during construction. Hardware shall be adjusted for proper operation. Sign surfaces shall be cleaned in accordance with manufacturer's instructions.

(END OF SECTION)

SECTION 10800**TOILET ACCESSORIES****PART 1 GENERAL****1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

CODE OF FEDERAL REGULATIONS (CFR)

36 CFR 1191 Americans with Disabilities Act (ADA) Accessibility Guidelines for
Buildings and Facilities

FEDERAL SPECIFICATIONS (FS)

FS DD-M-411 (Rev C) Mirrors, Glass
FS WW-P-541/GEN (Rev E; Am 1) Plumbing Fixtures
FS WW-P-541/8 (Rev B; Am 1) Plumbing Fixtures (Accessories, Land Use)

1.2 SUBMITTALS

The following shall be submitted:

Data

Finishes; Accessory Items;

Manufacturer's descriptive data and catalog cuts indicating materials of construction, fasteners proposed for use for each type of wall construction, mounting instructions, and operation instructions.

1.3 DELIVERY, STORAGE, AND HANDLING

Toilet accessories shall be wrapped for shipment and storage, delivered to the jobsite in manufacturer's original packaging and stored in a clean, dry area protected from construction damage and vandalism.

PART 2 PRODUCTS**2.1 MANUFACTURED UNITS**

Toilet accessories shall be provided where indicated in accordance with paragraph SCHEDULE. Each accessory item shall be complete with the necessary mounting plates, shall be of sturdy construction with corrosion resistant surface.

2.1.1 Anchors and Fasteners

Anchors and fasteners shall be capable of developing a restraining force commensurate with the strength of the accessory to be mounted and shall be suited for use with the supporting construction. Exposed fasteners shall be of tamperproof design and shall be finished to match the accessory.

2.1.2 Finishes

Finishes on metal shall be provided as follows:

Metal	Finish
_____	_____
Stainless steel	No. 4 satin finish

2.2 ACCESSORY ITEMS

Accessory items shall conform to the requirements specified below.

2.2.1 Grab Bar (GB)

Grab bar shall conform to FS WW-P-541/GEN and FS WW-P-541/8, Type IV, Class 2, 32 mm (1-1/4 inches) OD stainless steel. Grab bar set shall be one 42-inch length and one 36-inch length as indicated on the drawings. Concealed mounting flange shall have set screw mounting holes concealed on the lip of the flange. Grab bar shall have a smooth finish. Installed bars shall be capable of withstanding a 2.225 kN (500 pound) vertical load without coming loose from the fastenings and without obvious permanent deformation.

2.2.2 Mirror, Glass (MG)

Glass mirror shall conform to FS DD-M-411, Class 2, Style E, Grade 1. Mirror glass glazing shall be as described in SECTION 08810 GLASS AND GLAZING.

2.2.3 Combination Paper Towel Dispenser/Waste Receptacle Units(PTDWR)

Dispenser/receptacle shall be semi-recessed and shall have a capacity of 600 sheets of C-fold, single-fold, or quarter-fold towel. Waste receptacle shall be designed to be locked in unit and removable for service. Locking mechanism shall be tumbler key lock. Waste receptacle shall have a capacity of 12 gallons. Unit shall be fabricated of not less than 0.8 mm (0.30 inch) stainless steel welded construction with all exposed surfaces having a satin finish. Waste receptacle that accepts reusable liner standard for unit manufacturer shall be provided.

2.2.4 Soap Dispenser (SD)

Soap dispenser shall be surface mounted, liquid type consisting of a vertical Type 304 stainless steel tank with holding capacity of 1.2 L (40 fluid ounces) with a corrosion-resistant all-purpose valve that dispenses liquid soaps, lotions, detergents and antiseptic soaps.

2.2.5 Toilet Tissue Dispenser (TTD)

Toilet tissue holder shall be Type II - surface mounted with two rolls of tissue stacked vertically. Cabinet shall be stainless steel, satin finish.

PART 3 EXECUTION

3.1 INSTALLATION

Toilet accessories for handicap facilities shall be installed at heights and locations as required by 36 CFR 1191. Toilet accessories shall be securely fastened to the supporting construction in accordance with the manufacturer's approved instructions. Accessories shall be protected from damage from the time of installation until acceptance.

3.2 SCHEDULE

Accessories Required

Room or Space	MG	PTD/WR	SD	TTD	GB
RESTROOM (HANDICAP)	_1_	_1_	_1_	_1_	_1 set_
SHOWER ROOM	_1__	_1_	_1_	_1_	_0_

(END OF SECTION)

SECTION 11401**ELECTRIC KITCHEN EQUIPMENT****PART 1 GENERAL****1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1996) National Electrical Code

UNDERWRITERS LABORATORIES INC. (UL)

UL 250 (1993; R 1994, Bul. 1995 and 1996) Household Refrigerators and Freezers

UL 923 (1995) Microwave Cooking Appliances

1.2 Omitted**1.3 SUBMITTALS**

Submit the following:

Manufacturer's Catalog Data

- a. Kitchen equipment

PART 2 PRODUCTS**2.1 KITCHEN EQUIPMENT****2.1.1 Materials**

Except as modified herein, provide manufacturer's standard materials for kitchen equipment. Provide quantities, physical dimensions, and electrical characteristics as indicated. Color shall be white unless stated otherwise.

2.1.2 Omitted**2.1.3 Omitted****2.1.4 Refrigerator**

UL 250, refrigerator, minimum 20 cubic feet. Refrigerator/ freezer shall have the following or equal interior characteristics: adjustable cabinet shelves, ice maker, door shelves with gallon door bin. Freezer shall be self defrosting. Provide adjustable roller levelers.

2.1.5 Microwave Oven

UL 923, under counter mounted, with black glass window door, minimum one cubic foot capacity, automatic oven light, 10 power levels, automatic temperature controllers, minimum two automatic memory levels, digital time

controllers, and electronic touch-control panel.

2.1.6 Kitchen Range Hood

Kitchen range hood complete with fan, washable filter and back-draft damper shall be constructed of painted steel. Size shall be 30 inches long by 17 inches wide by a minimum of 5 inches high, with a minimum HVI certified rating of 125 CFM at the external static pressure of 0.5 inches. A light, switched separately from the fan, shall be located on the inside of hood. Fans shall be operated with a switch mounted on the hood or by a flush wall switch. Ducts shall be metal extending directly to the outside. Hoods shall conform to and be installed in accordance with requirements of the Underwriters Laboratories, Inc.

PART 3 EXECUTION

3.1 INSTALLATION

NFPA 70, Section 15400, "Plumbing," Install kitchen equipment in accordance with manufacturers' instructions.

3.2 FIELD QUALITY CONTROL

Conduct inspection and testing in the presence of the Contracting Officer.

3.2.1 Field Inspection

Before and after installation, inspect each piece of kitchen equipment for compliance with specified requirements.

3.2.2 Operation Tests

Upon completion, but before final acceptance, perform operation tests on each piece of equipment to determine that components, including controls, safety devices, and attachments, operate properly and in accordance with specified requirements.

(END OF SECTION)

**SECTION 12390
CABINETS AND COUNTERTOPS**

PART 1 GENERAL

1.0 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A156.9 (1988) Cabinet Hardware

KITCHEN CABINET MANUFACTURERS ASSOCIATION (KCMA)

KCMA A161.1 (1990; Errata May 1991) Recommended Performance & Construction
Standards for Kitchen and Vanity Cabinets

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA LD 3 (1991) High-Pressure Decorative Laminates

1.1 DESIGN

Cabinets shall be all wood, factory-fabricated and finished in the manufacturer's standard sizes and finishes of the type, design, and configuration indicated. Cabinets shall be constructed as specified and shall meet the requirements of KCMA A161.1. Wall and base cabinet assemblies shall consist of individual units joined into continuous sections. Fastenings shall be accomplished to permit removal and replacement of individual units without affecting the remainder of the installation. Counters shall be provided with watertight sink rim when indicated. Drawers shall be removable and shall be equipped with position stops to avoid accidental complete withdrawals. Shelves shall be fixed or adjustable as indicated. There shall be no particle board construction allowed.

1.2 SUBMITTALS

The following shall be submitted:

Data

Cabinets and Countertops

Manufacturer's printed data, catalog cuts, and installation instructions.

Drawings

Cabinets and Countertops

Drawings showing each type of cabinet and related item, and clearly indicating the complete plan and elevations of the cabinets and accessories and pertinent details of construction, fabrication, and attachments.

1.3 DELIVERY AND STORAGE

Cabinets shall be delivered to the job site wrapped in a protective covering. Cabinets shall be stored in an adequately ventilated, dry location that is free of dust, water, or other contaminants and in a manner to permit access

for inspection and handling. Cabinets shall be handled carefully to prevent damage to the surfaces. Damaged items that cannot be restored to like-new condition shall be replaced.

PART 2 PRODUCTS

2.1 CABINETS

Wall and base cabinets shall be of the same construction and same outside appearance. Door design shall be framed inset hardwood panels. Corner cabinets shall be equipped with full circle shelves where indicated. Shelves shall be fixed or fully adjustable as indicated. Adjustable shelves shall be capable of adjusting on approximately 31mm (1-1/4 inch) increments. Shelves shall be supported by self-locking clips or wood dowels. Dowels shall be approximately 8 mm (5/16 inch) in diameter by 39 mm (1-9/16 inches) long. Dowels shall be inserted into borings for the shelf adjustments. Shelves shall be minimum 13mm (1/2 inch) thick plywood. Drawer fronts shall be 19mm (3/4 inch) thick solid hardwood frame with 11mm (7/16 inch) solid wood panel. Drawer sides and backs shall be of solid wood construction. Drawer bottoms shall be constructed of 9 mm (3/8 inch) plywood.

2.1.1 Frame Type Cabinets

The cabinets shall be constructed with frame fronts and solid ends, or frame construction throughout. Frame members shall be 19 mm (3/4 inch) thick by 38 mm (1-1/2 inch) wide; kiln-dried hardwood, glued together, and shall be either mortised and tenoned, dovetailed or doweled, nailed, stapled or screwed. Top and bottom corners shall be braced with either hardwood blocks that are glued together with water resistant glue and nailed in place, or metal or plastic corner braces. Backs of wall cabinets shall be 3 mm (1/8 inch) thick plywood or tempered hardboard. Backs of base and tall cabinets shall be 9 mm (3/8 inch) thick hardwood plywood. Bottoms of cabinets shall be minimum 9 mm (3/8 inch) thick plywood good grade and shall be braced with wood members glued in place. Cabinet ends shall be 16 mm (5/8 inch) thick hardwood plywood.

2.2 COUNTERTOPS AND BACKSPLASH

2.2.1 General

Countertop and backsplash shall be constructed of 19 mm (3/4 inch) thick plywood and shall be post-formed cove type. Cove type shall be a single unit with self-edging and plastic laminate coved at the juncture of the countertop and backsplash. Backsplash shall be not less than 88 mm (3-1/2 inches) high. Edging and trim shall consist of plastic laminate cut and fitted to all exposed edges. End splashes constructed of 19 mm (3/4 inch) plywood shall be supplied.

2.2.2 Sink Rims

Sink rims shall be of the corrosion resistant steel clamping type, sized to the sink, and a standard product of a manufacturer regularly producing this type of equipment.

2.3 FINISH

2.3.1 Cabinet Finish

Cabinets shall be provided with a factory-applied durable finish of a type standard with the manufacturer. Natural finish wood doors, drawer fronts, cabinet fronts, and exposed cabinet sides shall be fabricated of wood which will be free of extreme color variations within each panel or between adjacent panels. Exposed exterior surfaces shall be hardwood or grade A-A hardwood veneer with natural stain and sprayed on polyurethane factory applied finish. Colors shall be selected from manufacturer's standard.

2.3.2 Laminates on Countertops

Continuous sheets of longest lengths practicable shall be provided. Joints in surface sheeting shall be tight and flush and held to a practicable minimum. When the countertop and backsplash are two separate units, GP50 plastic laminate shall be used. When the countertop and backsplash are one unit, PF42 plastic laminate shall be used. Plastic laminate shall conform to the requirements of NEMA LD 3 and plastic laminate adhesive shall be contact type applied to both surfaces. For cove type countertops, the post-forming plastic laminate shall not be bent to a radius smaller than the limit recommended by the plastic manufacturer. Design, color, and finish shall be selected from manufacturer's standard.

2.3.3 Backer Sheets

Backer Sheets of high-pressure plastic laminate, shall conform to NEMA LD 3, Grade BK20 and shall be applied to the underside of all core material. Design, color, and finish shall be selected from manufacturer's standard.

2.4 HARDWARE

Hardware shall conform to BHMA A156.9, shall be suitable for kitchen cabinet use, and shall include all miscellaneous hardware for a complete installation. Door hinges shall be self-closing type. Drawer runners shall have nylon rollers standard with the manufacturer. Hardware and fastenings for doors and drawers shall be of the through-bolt type. The types and finishes of hardware shall be as follows:

BHMA DESIGNATION

TYPE	NUMBER	FINISH
Door/ Drawer Pulls(3-inch centers)	B02011	Antique Brass
Door Hinges	B01602	-----
Drawer Hinges	B05051	Epoxy Coated
Shelf Hinges	B04102	-----
	or B04013	

PART 3 EXECUTION

3.1 INSTALLATION

Cabinets shall be installed level, plumb, and true to line, and shall be attached to the walls or floors with suitable devices to securely anchor each unit. Countertops, accessories, and hardware shall be installed as indicated. Installation shall be in accordance with the manufacturer's approved printed instructions. The inner edge of sink cutouts in laminated plastic tops shall be painted with a coat of semi-gloss enamel paint and sink flanges shall be set in a bed of sealant. Closer and filler strips and finish moldings shall be provided as required. Prior to final acceptance, doors shall be aligned, hardware adjusted, and cabinets left in a clean neat condition.

(END OF SECTION)

SECTION 13120**STANDARD METAL BUILDING SYSTEMS****PART 1 GENERAL****1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC-S303	(1992) Code of Standard Practice for Steel Buildings and Bridges
AISC-S329	(1986) Allowable Stress Design Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI SG-673	(1987) Cold-Formed Steel Design Manual
-------------	--

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36	(1994a) Carbon Structural Steel
ASTM A 325	(1994) Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 446	(1993) Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality
ASTM A 490	(1993) Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
ASTM A 529	(1994) High-Strength Carbon-Manganese Steel of Structural Quality
ASTM A 570	(1992; R 1993) Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality
ASTM A 572	(1994b) High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 588	(1994) High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4 in. (100 mm) Thick
ASTM A 606	(1991a; R 1993) Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance
ASTM A 607	(1992a) Steel, Sheet and Strip, High-Strength, Low-Alloy, Columbium or Vanadium, or Both, Hot-Rolled and Cold-Rolled
ASTM A 792	(1993a) Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process, General Requirements

ASTM B 117	(1994) Operating Salt Spray (Fog) Testing
ASTM C 518	(1991) Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
ASTM C 553	(1992) Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM D 522	(1993a) Mandrel Bend Test of Attached Organic Coatings
ASTM D 714	(1987; R 1994) Evaluating Degree of Blistering of Paints
ASTM D 968	(1993) Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D 1308	(1987; R 1993) Effect of Household Chemicals on Clear and Pigmented Organic Finishes
ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 2244	(1993) Calculation of Color Differences from Instrumentally Measured Color Coordinates
ASTM D 2247	(1994) Testing Water Resistance of Coatings in 100 % Relative Humidity
ASTM D 2794	(1993) Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D 3359	(1995) Measuring Adhesion by Tape Test
ASTM D 4214	(1989) Evaluating the Degree of Chalking of Exterior Paint Films
ASTM E 96	(1994) Water Vapor Transmission of Materials
ASTM G 23	(1995) Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(1994) Structural Welding Code - Steel
----------	--

UNDERWRITERS LABORATORIES (UL)

UL 580	(1994; Rev thru Apr 1995) Tests for Uplift Resistance of Roof Assemblies
--------	--

1.2 GENERAL

1.2.1 Building Configuration

The structural components for a metal building are provided by the Government. Building has vertical walls and gable roof. Roof slope is as indicated. Buildings is a single-span structure with rigid frames. Building dimensions are those indicated on the drawings. The clear opening between the finished floor and the bottom of the roof steel is as indicated.

1.2.2 Manufactured Building

The metal building is a product of a recognized metal building systems manufacturer ("Star".) All building components necessary to fulfill the requirements of the drawings are not furnished by the Government. The contractor shall determine from the drawings which components are to be provided for a complete and usable building.

1.2.3 Installer

Erector shall have specialized experience in the erection of metal building systems for a period of at least 3 years.

1.3 Foundation Requirements

Foundations shall be designed for an allowable soil bearing pressure of 2500 pounds per square foot, a minimum bottom of footing depth of two feet below finish floor elevation, a factor of safety of 1.5 for overturning, sliding and uplift, and a concrete compressive strength as specified in Section 03300 CONCRETE FOR BUILDING CONSTRUCTION.

1.3.1 Framing and Structural Members

Structural cold-formed steel framing members and their connections shall be designed in accordance with AISI SG-673. Framed openings shall be designed to structurally replace the covering and framing displaced. The allowable live load deflection of roof elements shall not exceed 1/180th of the span. Members with openings in their webs shall be designed with consideration of the additional stresses which will result due to the openings. Deflections of the steel framing above and along the side of rolling door openings shall be limited to a maximum of 1/2 of the allowable movement in the telescoping top roller of the doors to ensure proper operation of the doors.

1.3.2 Exterior Covering

Except as otherwise specified, steel covering shall be designed in accordance with AISI SG-673. Maximum deflection for wall and roof panels under full dead and live and/or wind loads shall not exceed 1/180th of the span between supports. The design analysis shall establish that the roof when deflected under dead plus live or snow loads, will not result in a negative gradient. Maximum deflections shall be based on sheets continuous across two or more supports with sheets unfastened and fully free to deflect. In addition to the loads indicated above, the roof decking shall be designed for a 200 pound concentrated load at midspan on a 12 inch wide section of deck. Panels thinner than 0.03 inches are not permitted for diaphragms used to resist seismic loads in Seismic Zones 2 through 4.

1.3.3 Ventilators

1.3.3.1 Ventilator

Roof ventilator shall be ridge mounted gravity type, provided by the Government.

1.4 SUBMITTALS

The following shall be submitted:

Data

Design Analysis;

The design analysis signed by a Registered Professional Engineer shall include a list of the design loads, and complete calculations for the building foundations. The design analysis shall include, but not be limited to, the following wind and seismic information:

Drawings and details.

Design shall be accompanied by a letter of certification, signed by a Registered Professional Engineer, stating the design criteria and procedures used and attesting to the adequacy and accuracy of the design.

Plans

The contractor shall use the information provided from the government drawings to create an anchor bolt plan.

Samples

Roof and Wall Covering;

One piece of each type and finish to be used, 9 inches long, full width. The sample for factory color finished covering shall be accompanied by certified laboratory test reports showing that the sheets to be furnished are produced under a continuing quality control program and that a representative sample consisting of not less than 5 pieces has been tested and has met the quality standards specified for factory color finish.

Insulation;

Descriptive data and instructions covering installation.

Gaskets and Insulating Compounds;

Descriptive data.

Sealant;

Descriptive data.

1.5 DELIVERY AND STORAGE

Materials shall be delivered to the site in a dry and undamaged condition and stored out of contact with the ground. Materials other than framing and structural members shall be covered with weather-tight coverings and kept dry. Storage accommodations for roof and wall covering shall provide good air circulation and protection from surface staining.

1.6 GUARANTEE

The metal building system shall be guaranteed against water leaks arising out of or caused by ordinary wear and tear by the elements for a period of 5 years. Such guarantee shall start upon final acceptance of the work or the date the Government takes possession, whichever is earlier.

PART 2 PRODUCTS

2.1 BUILDING COMPONENTS

Each piece or part of the assembly shall be clearly and legibly marked to correspond with the detail drawings.

2.2 FRAMING MEMBERS

NOTE: Not all framing members are provided by the Government. See drawings for members to be furnished by the contractor.

Steel, 1/8 inch or more in thickness shall conform to ASTM A 36, ASTM A 529, ASTM A 572, or ASTM A 588. Uncoated steel less than 1/8 inch in thickness shall conform to ASTM A 570, ASTM A 606, or ASTM A 607. Galvanized steel shall conform to ASTM A 446, G 90 coating designation, 0.045 inch minimum thickness. Holes for bolts shall be made in the shop.

2.3 ROOF AND WALL COVERING

Note: Not all roof and wall covering is provided by the government. See drawings for extent of roof and wall panels to be furnished by the contractor.

Panels shall be steel and shall have a factory color finish. Length of sheets shall be sufficient to cover the entire length of any unbroken roof slope or the entire height of any unbroken wall surface. Width of sheets with overlapping configurations shall provide not less than 24 inches of coverage in place. Design provisions shall be made for thermal expansion and contraction consistent with the type of system to be used. All sheets shall be square cut.

2.3.1 Roof Panels

Roof Panels shall have configurations for overlapping sheets. Roof deck assemblies shall be Class 90 as defined in UL 580. System for securing the roof covering to structural framing members shall be exposed, penetrating fastener type. The ridge cap shall not have exposed fasteners. Height of corrugation at overlap of adjacent roof sheets shall match existing panels.

2.3.2 Wall Panels

Wall panels shall have configurations for overlapping adjacent sheets. Wall covering shall be fastened to framework using exposed fasteners.

2.3.3 Steel Covering

Zinc-coated steel conforming to ASTM A 446, G 90 coating designation; aluminum-zinc alloy coated steel conforming to ASTM A 792, AZ 55 coating. Panels shall be 0.024 inch thick minimum.

2.3.4 Factory Color Finish

Wall and roof panels shall have a factory applied polyvinylidene fluoride finish on the exposed side. The exterior finish shall consist of a baked-on fluoropolymer enamel topcoat with an appropriate prime coat. Color shall match existing roof panels. The exterior coating shall be a nominal 1 mil thickness consisting of a polyvinylidene fluoride topcoat of not less than 0.7 mil dry film thickness and the paint manufacturer's recommended primer of not less than 0.2 mil thickness. The interior color finish shall consist of a nominal 1 mil thick polyvinylidene fluoride finish otherwise the same as the exterior. The exterior color finish shall meet the test requirements specified below.

2.3.4.1 Salt Spray Test

A sample of the sheets shall withstand a salt spray test for a minimum of 1000 hours in accordance with ASTM B 117, including the scribe requirement in the test. Immediately upon removal of the panel from the test, the coating shall receive a rating of as determined by ASTM D 714; and a rating of 1/8 inch failure at scribe, as determined by ASTM D 1654.

2.3.4.2 Formability Test

When subjected to testing in accordance with ASTM D 522, the coating film shall show no evidence of fracturing to the naked eye.

2.3.4.3 Accelerated Weathering, Chalking Resistance and Color Change

A sample of the sheets shall be tested a minimum of 1000 hours in accordance with ASTM G 23, using a Type EH apparatus with cycles of 60 minutes radiation and 60 minutes condensing humidity. The coating shall withstand the weathering test without cracking, peeling, blistering, loss of adhesion of the protective coating, or corrosion of the base metal. Protective coating that can be readily removed from the base metal with tape in accordance with ASTM D 3359, Test Method B, shall be considered as an area indicating loss of adhesion. Following the accelerated weathering test, the coating shall have a chalk rating not less than No. 8 in accordance with ASTM D 4214 test procedures, and the color change shall not exceed 5 CIE or Hunter Lab color difference (delta E) units in accordance with ASTM D 2244.

2.3.4.4 Humidity Test

When subjected to a humidity cabinet in accordance with ASTM D 2247 for 1000 hours, a scored panel shall show no signs of blistering, cracking, creepage or corrosion.

2.3.4.5 Impact Resistance

Factory-painted sheet shall withstand direct and reverse impact in accordance with ASTM D 2794 equal to 1.5 times metal thickness in mils, expressed in inch pounds, with no loss of adhesions.

2.3.4.6 Abrasion Resistant Test

When subjected to the falling sand test in accordance with ASTM D 968, the coating system shall withstand a minimum of 50 liters of sand before the appearance of the base metal. The term "appearance of base metal" refers to the metallic coating on steel or the aluminum base metal.

2.3.4.7 Omitted

2.3.4.8 Pollution Resistance

Coating shall show no visual effects when immersion tested in a 10 percent hydrochloric acid solution for 24 hours in accordance with ASTM D 1308.

2.3.5 Accessories

Flashing, trim, metal closure strips and curbs, fascia, caps, and similar metal accessories shall be not less than the minimum thickness specified for covering. Accessories shall be compatible with the system furnished. Exposed metal accessories shall be finished to match the covering building finish. Molded closure strips shall be bituminous-saturated fiber, closed-cell or solid-cell synthetic rubber or neoprene, or polyvinyl chloride premolded to match configuration of the covering and shall not absorb or retain water.

2.4 FASTENERS

Fasteners for steel wall and roof panels shall be zinc-coated steel, aluminum, corrosion resisting steel, or nylon capped steel, type and size specified below or as otherwise approved for the applicable requirements. Fasteners for structural connections shall provide both tensile and shear strength of not less than 750 pounds per fastener. Fasteners for accessories shall be the manufacturer's standard. Exposed roof fasteners shall be gasketed or have gasketed washers on the exterior side of the covering to waterproof the fastener penetration. Washer material shall be compatible with the covering; have a minimum diameter of 3/8 inch for structural connections; and gasketed portion of fasteners or washers shall be neoprene or other equally durable elastomeric material approximately 1/8 inch thick. When wall covering is factory color finished, exposed wall fasteners shall be color finished or provided with plastic color caps to match the covering.

2.4.1 Screws

Screws shall be as recommended by the manufacturer to meet the strength design requirements of the panels.

2.4.2 End-Welded Studs

Automatic end-welded studs shall be shouldered type with a shank diameter of not less than 3/16 inch and cap or nut for holding covering against the shoulder.

2.4.3 Explosive Actuated Fasteners

Fasteners for use with explosive actuated tools shall have a shank diameter of not less than 0.145 inch with a shank length of not less than 1/2 inch for fastening panels to steel and not less than 1 inch for fastening panels to concrete.

2.4.4 Blind Rivets

Blind rivets shall be aluminum with 3/16 inch nominal diameter shank or stainless steel with 1/8 inch nominal diameter shank. Rivets shall be threaded stem type if used for other than the fastening of trim. Rivets with hollow stems shall have closed ends.

2.4.5 Bolts

Bolts shall be not less than 1/4 inch diameter, shouldered or plain shank as required, with proper nuts.

2.5 Omitted.

2.6 Omitted

2.7 Omitted

2.8 Omitted

2.9 Omitted

2.10 Omitted

2.11 DOORS

2.11.1 Hinged Doors

Hinged doors and frames shall conform to the requirements of Section 08110 STEEL DOORS AND FRAMES. Hardware shall be as specified in Section 08700 BUILDERS' HARDWARE.

2.11.2 Omitted

2.11.3 Overhead Doors

Overhead doors shall be as specified in SECTION 08330, OVERHEAD ROLLING DOORS.

2.12 WINDOWS

Windows shall be as specified in SECTION 08520, ALUMINUM WINDOWS.

2.13 INSULATION

Thermal resistance of insulation shall be not less than the R-values shown on the contract drawings. R-values shall be determined at a mean temperature of 75 degrees F in accordance with ASTM C 518. Insulation shall be a

standard product with the insulation manufacturer, factory marked or identified with insulation manufacturer's name or trademark and R-value. Identification shall be on individual pieces or individual packages. Blanket insulation shall have a facing as specified in paragraph VAPOR RETARDER. The stated R-value of the insulation shall be certified by an independent Registered Professional Engineer if tests are conducted in the insulation manufacturer's laboratory.

2.13.1 Blanket Insulation

Blanket insulation shall conform to ASTM C 553.

2.13.2 Omitted.

2.14 Omitted

2.15 SEALANT

Sealant shall be an elastomeric type containing no oil or asphalt. Exposed sealant shall be colored to match the applicable building color and shall cure to a rubberlike consistency. Concealed sealant may be the nonhardening type.

2.16 GASKETS AND INSULATING COMPOUNDS

Gaskets and insulating compounds shall be nonabsorptive and suitable for insulating contact points of incompatible materials. Insulating compounds shall be nonrunning after drying.

2.17 VAPOR RETARDER

2.17.1 Vapor Retarders as Integral Facing

Insulation facing shall have a permeability of 5.7 ng per Pa-second-square meter 0.1 perm or less when tested in accordance with ASTM E 96. Facing shall be white of reinforced foil with a vinyl finish. Facings and finishes shall be factory applied. The integral facing shall be used to support the insulation .

2.18 SHOP PRIMING

Ferrous surfaces shall be cleaned of oil, grease, loose rust, loose mill scale, and other foreign substances and shop primed. Primer coating shall be in accordance with the manufacturer's standard system.

PART 3 EXECUTION

3.1 ERECTION

3.1.1 General

Erection shall be in accordance with the approved erection instructions and drawings. The completed building shall be free of excessive noise from wind-induced vibrations under the ordinary weather conditions to be encountered at the location where the building is erected, and meet all specified design requirements. Dissimilar materials which are not compatible when contacting each other shall be insulated from each other by means of gaskets or insulating compounds. Framing members fabricated or modified on site shall be saw or abrasive cut; bolt holes shall be drilled. On-site flame cutting of framing members, with the exception of small access holes in structural beam or column webs, shall not be permitted. Improper or mislocated drill holes shall be plugged with an oversize screw fastener and gasketed washer; however, sheets with an excess of such holes or with such holes in critical locations shall not be used. Improper or mislocated bolt holes in structural members or other misfits caused by improper fabrication or erection, shall be repaired in accordance with AISC-S303. Exposed surfaces shall be kept clean and free from sealant, metal cuttings, excess material from thermal cutting, and other foreign materials. Exposed

surfaces which have been thermally cut shall be finished smooth within a tolerance of 1/8 inch. Stained, discolored or damaged sheets shall be removed from the site. Welding of steel shall conform to AWS D1.1. High-strength bolting shall conform to AISC-S329 using ASTM A 325 or ASTM A 490 bolts. Concrete work is specified in Section 03300 CONCRETE FOR BUILDING CONSTRUCTION.

3.1.2 Framing and Structural Members

Anchor bolts shall be accurately set by template while the concrete is in a plastic state. Uniform bearing under base plates and sill members shall be provided using a nonshrinking grout when necessary. Members shall be accurately spaced to assure proper fitting of covering. Separate leveling plates under column base plates shall not be used. As erection progresses, the work shall be securely fastened to resist the dead load and wind and erection stresses.

3.1.3 Wall Covering and Roof Covering

Wall covering shall be applied with the longitudinal configurations in the vertical position. Roof covering shall be applied with the longitudinal configurations in the direction of the roof slope. Accessories shall be fastened into framing members, except as otherwise approved. New closure strips and gasketed screws shall be provided by the contractor to provide weather-tight construction. Metal panels provided by the government shall be cut as required to satisfy drawing elevations.

3.1.3.1 Lap Type Panels with Exposed Fasteners

Except for self-framing buildings, end laps shall be made over framing members with fasteners into framing members approximately 2 inches from the end of the overlapping sheet. Side laps shall be laid away from the prevailing winds. Side lap distances, end lap distances, joint sealing, and spacing and fastening of fasteners shall be in accordance with the manufacturer's standard practice insofar as the maximum spacings specified are not exceeded and provided such standard practice will result in a structure which will be free from water leaks and meet design requirements. Spacing of fasteners shall present an orderly appearance and shall not exceed: 8 inches on center at end laps of covering, 12 inches on center at connection of covering to intermediate supports, 12 inches on center at side laps of roof coverings, and 18 inches on center at side laps of wall coverings except when otherwise approved. Side laps and end laps of roof and wall covering and joints at accessories shall be sealed. Fasteners shall be installed in straight lines within a tolerance of 1/2 inch in the length of a bay. Fasteners shall be driven normal to the surface and to a uniform depth to properly seat the gasketed washers.

3.1.4 Metal Trim

Prefinished metal trim shall be provided by the contractor where indicated on the drawings.

3.1.5 Louvers and Ventilators

Louvers and ventilators shall be rigidly attached to the supporting construction in a manner to assure a rain-tight installation.

3.1.6 Omitted..

3.1.7 Insulation Installation

Insulation shall be installed as indicated and in accordance with manufacturer's instructions.

3.1.7.1 Blanket Insulation

Blanket insulation shall be installed over the purlins and held tight against the metal roofing. It shall be supported by an integral facing or other commercially available support system. Spacers shall be provided as required to accommodate thickness of insulation when fastening roof panels.

3.1.8 Omitted.

3.1.9 Vapor Retarder Installation

3.1.9.1 Integral Facing on Blanket Insulation

Integral facing on blanket insulation shall have the facing lapped and sealed with a compatible tape to provide a vapor tight membrane.

3.1.10 Slip Sheet Installation

A slip sheet shall be laid over the blanket insulation facing to prevent the vinyl facing from adhering to the metal roofing.

3.2 FIELD PAINTING

Immediately upon detection, abraded or corroded spots on shop-painted surfaces shall be wire brushed and touched up with the same material used for the shop coat. Shop-primed ferrous surfaces exposed on the outside of the building and all shop-primed surfaces of doors and windows shall be painted with two coats of an approved exterior enamel. Factory color finished surfaces shall be touched up as necessary with the manufacturer's recommended touch-up paint.

(END OF SECTION)

SECTION 15250**THERMAL INSULATION FOR MECHANICAL SYSTEMS****PART 1 GENERAL****1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1993) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 580	(1993) Stainless and Heat Resisting Steel Wire
ASTM B 209	(1992a) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C 195	(1990) Mineral Thermal Insulating and Cement
ASTM C 449	(1988) Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
ASTM C 534	(1994) Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
ASTM C 552	(1991) Cellular Glass Thermal Insulation
ASTM C 553	(1992) Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C 612	(1993) Mineral Fiber Block and Board Thermal Insulation
ASTM C 647	(1989a) Properties and Tests of Mastics and Coating Finishes for Thermal Insulation
ASTM C 795	(1992) Thermal Insulation for Use in Contact With Austenitic Stainless Steel
ASTM C 920	(1987) Elastomeric Joint Sealants
ASTM C 921	(1989) Determining the Properties of Jacketing Materials for Thermal Insulation
ASTM D 3278	(1989) Test Methods for Flash Point of Liquids by Setaflash Closed-Cup Apparatus
ASTM E 84	(1994) Surface Burning Characteristics of Building Materials
ASTM E 96	(1994) Water Vapor Transmission of Materials

FEDERAL SPECIFICATIONS (FS)

FS L-P-535 (Rev E; Notice 2) Plastic Sheet (Sheeting): Plastic Strip: Poly(Vinyl Chloride) and Poly(Vinyl Chloride-Vinyl Acetate), Rigid

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-69 (1991) Pipe Hangers and Supports - Selection and Application

MIDWEST INSULATION CONTRACTORS ASSOCIATION (MICA)

MICA-01 (1993) National Commercial & Industrial Insulation Standards

MILITARY SPECIFICATIONS (MS)

MS MIL-A-24179 (Rev A; Am 2, Notice 1) Adhesive, Flexible Unicellular-Plastic Thermal Insulation

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A (1993) Installation of Air Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES (UL)

UL 723 (1993; Rev Apr 1994) Test for Surface Burning Characteristics of Building Materials

1.2 SYSTEM DESCRIPTION

Field-applied insulation and accessories on mechanical systems shall be as specified herein; factory-applied insulation is specified under the piping, duct or equipment to be insulated.

1.3 GENERAL QUALITY CONTROL

1.3.1 Standard Products

Materials shall be the standard products of manufacturers regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

1.3.2 Installer's Qualifications

Qualified installers shall have successfully completed three or more similar type jobs within the last 5 years.

1.3.3 Surface Burning Characteristics

Unless otherwise specified, insulation not covered with a jacket shall have a flame spread rating no higher than 75 and a smoke developed rating no higher than 150. The outside surface of insulation systems which are located in air plenums, in ceiling spaces, and in attic spaces shall have a flame spread rating no higher than 25 and a smoke developed rating no higher than 50. Insulation materials located exterior to the building perimeter are not required to be fire-rated. Flame spread and smoke developed ratings shall be determined by ASTM E 84. Insulation shall be tested in the same density and installed thickness as the material that shall be used in the actual construction. Jackets shall comply with the flame spread and smoke developed ratings required by ASTM C 921.

1.3.4 Identification of Materials

Packages or standard containers of insulation, jacket material, cements, adhesives, and coatings delivered for use, and samples required for approval shall have manufacturer's stamp or label attached giving the name of the manufacturer and brand, and a description of the material.

1.4 SUBMITTALS

The following shall be submitted for government approval:

1.4.1 Data

1.4.1.1 Thermal Insulation Materials;

A complete list of materials, including manufacturer's descriptive and technical literature, performance data, catalog cuts, and installation instructions. Materials furnished under this section of the specification shall be submitted at one time. A schedule indicating the product number, k-value, thickness and furnished accessories for each mechanical system requiring insulation shall be included.

1.5 STORAGE

Materials shall be delivered in the manufacturer's unopened containers. Materials delivered and placed in storage shall be provided with protection from weather, humidity, dirt, dust and other contaminants by the Contractor. Insulation material and supplies that become dirty, dusty, wet, or otherwise contaminated may be rejected by the Contracting Officer.

PART 2 PRODUCTS

2.1 GENERAL MATERIALS

Materials shall be compatible and shall not contribute to corrosion, soften, or otherwise attack surfaces to which applied in either the wet or dry state. Materials to be used on stainless steel surfaces shall meet ASTM C 795 requirements. Materials shall be asbestos free and conform to the following:

2.1.1 Adhesives

2.1.1.1 Omitted

2.1.1.2 Mineral Fiber Insulation Cement

Cement shall be in accordance with ASTM C 195.

2.1.1.3 Contact Adhesive

Adhesive shall be in accordance with MS MIL-A-24179, Type II, Class 1 or Type II.

2.1.1.4 Lagging Adhesive

Lagging adhesives shall be nonflammable, fire-resistant in accordance with NFPA 90A, UL 723, and ASTM E 84. Adhesives shall be either the Class 1 or Class 2 type. Class 1 adhesive shall be pigmented white and be suitable for bonding fibrous glass cloth to faced and unfaced fibrous glass insulation board; for bonding cotton brattice cloth to faced and unfaced fibrous glass insulation board; for sealing edges of and bounding fibrous glass tape to joints of fibrous glass board; or for bonding lagging cloth to thermal insulation. Class 2 adhesive shall be pigmented white and be suitable for attaching fibrous glass insulation to metal surfaces. Lagging adhesives shall be applied in strict accordance with the manufacturer's recommendations.

2.1.2 Contact Adhesive

Adhesive may be dispersed in a nonhalogenated organic solvent with a low flash point (flash point plus or minus 25 degrees F or, dispersed in a nonflammable organic solvent which shall not have a fire point below 200 degrees F. The adhesive shall not adversely affect, initially or in service, the insulation to which it is applied, nor shall it cause any corrosive effect on metal to which it is applied. Any solvent dispersing medium or volatile component of the adhesive shall have no objectionable odor and shall not contain any benzene or carbon tetrachloride. The dried adhesive shall not emit nauseous, irritating, or toxic volatile matters or aerosols when the adhesive is heated to any temperature up to 2.2 degrees F. The adhesive shall be nonflammable, fire resistant conforming to ASTM E 84.

2.1.3 Caulking

ASTM C 920, Type S, Grade NS, Class 25, Use A.

2.1.4 Corner Angles

Nominal 0.016 inch aluminum 1 by 1 inch with factory applied kraft backing. Aluminum shall be ASTM B 209, Alloy 3003, 3105, or 5005.

2.1.5 Finishing Cement

Mineral fiber hydraulic-setting thermal insulating cement ASTM C 449.

2.1.6 Glass Tape

Glass tape shall meet the requirements of UL 723 and ASTM E 84.

2.1.6.1 Plain Weave, Untreated

The ends shall be properly interlocked with the picks to ensure that there shall be no raveling of the tape edges. It shall have an average weight of percent grams per 5.8 plus or minus 10 percent ounces per square yard, an average thickness of 0.007 plus or minus 0.001 inches, warp ends/wales of 42 plus or minus 2 per inch or filling picks/courses of 32 plus or minus 2 per inch, a minimum breaking strength of 150 pounds per inch of width, and after heating to 900 degrees F for 2 hours a minimum breaking strength of 40 pounds per inch of width.

2.1.6.2 Knitted, Untreated

The wales shall be properly interlocked with the courses to ensure that there shall be no raveling of the tape edges. It shall have an average weight of 4.5 plus or minus 10 percent ounces per square yard, an average thickness of 0.007 plus or minus 0.001 inches, warp end/wales of 16 plus or minus 2 per inch, a minimum breaking strength of 40 pounds per inch of width, and after heating to 900 degrees F for 2 hours a minimum breaking strength of 21 pounds per inch of width.

2.1.6.3 Distortion Requirements

There shall be no distortion of the tape when a sample 24 inches in length is spread across a flat horizontal surface and observed for evidence of distortion such as tendency to curl rather than lie flat. The width tolerance is plus or minus 1/8 inch.

2.1.6.4 Omitted

2.1.7 Glass Cloth

Glass cloth shall be an untreated light weight satin weave. It shall be woven with an eight-harness satin weave and shall be fabricated from fibrous glass yarn. The yarn shall be made from low twist continuous filament glass fiber.

The maximum average diameter of the glass fibers used for the yarns shall not exceed 0.000299 in. The cloth shall meet the requirements of UL 723.

2.1.8 Staples

Outward clinching type ASTM A 167, Type 304 or 316 stainless steel.

2.1.9 Jackets

ASTM C 921, Type I, moisture vapor transmission maximum 0.02 perms, puncture resistance minimum 50 Beach units on all surfaces except concealed ductwork, where a minimum puncture resistance of 25 Beach units is allowable, tensile strength minimum 35 pounds/inch width; Type II, puncture resistance minimum 25 Beach units, tensile strength minimum 20 pound/inch width. Aluminum jackets shall be corrugated, embossed or smooth sheet, 0.016 inch nominal thickness; ASTM B 209, Temper H14, Temper H16, Alloy 3003, 5005, or 3105 with factory applied moisture barrier. Corrugated aluminum jacket shall not be used outdoors. Aluminum jacket securing bands shall be Type 304 stainless steel, 0.015 inch thick, 1/2 inch wide for pipe under 12 inch diameter and 3/4 inch wide for pipe over 12 inch diameter. Aluminum jacket circumferential seam bands shall be 2 by 0.016 inch aluminum matching jacket material. Bands for insulation belowground shall be 3/4 by 0.020 inch thick stainless steel, or fiberglass reinforced tape. The jacket may, at the option of the Contractor, be provided with a factory fabricated Pittsburgh or "Z" type longitudinal joint. When the "Z" joint is used, the bands at the circumferential joints shall be designed by the manufacturer to seal the joints and hold the jacket in place. Polyvinyl chloride (PVC) jacket and fitting covers shall be FS L-P-535, Composition A, Type II, with minimum thickness 0.030 inch. Insulation under PVC jacket shall meet jacket manufacturer's written recommendations.

2.1.10 Vapor Barrier Coating

The vapor barrier coating shall be fire and water resistant and appropriately selected for either outdoor or indoor service. Color shall be white. The water vapor permeance of the compound shall not exceed 0.05 perm and shall be determined according to procedure B of ASTM E 96 utilizing apparatus described in ASTM E 96. The coating shall be a nonflammable, fire resistant type conforming to ASTM E 84, NFPA 90A, and UL 723. The flash point of the compound shall not be less than 80 degrees F and shall be determined in accordance with ASTM D 3278. All other application and service properties shall be in accordance with ASTM C 647.

2.1.11 Wire

Soft annealed ASTM A 580 Type 302, 304 or 316 stainless steel, 16 or 18 gauge.

2.2 PIPE INSULATION MATERIALS

Pipe insulation materials shall be as follows:

2.2.1 Aboveground Cold Pipeline

Insulation for minus 30 degrees to plus 60 degrees F shall be as follows:

2.2.1.1 Omitted

2.2.1.2 Omitted

2.2.1.3 Flexible Cellular Insulation

ASTM C 534, Type I.

2.2.2 Aboveground Hot Pipeline

For aboveground hot pipeline (above 60 degrees F) the following insulation requirements shall be met.

2.2.2.1 Omitted

2.2.2.2 Omitted

2.2.2.3 Cellular Glass

ASTM C 552, Type II and Type III.

2.3 DUCT INSULATION MATERIALS

Duct insulation materials shall be as follows:

2.3.1 Omitted

2.3.2 Flexible Mineral Fiber

ASTM C 553, Type I, Class B-2.

2.4 EQUIPMENT INSULATION MATERIALS

Equipment insulation materials shall be as follows:

2.4.1 Cold Equipment Insulation

For temperatures below 60 degrees F.

2.4.1.1 Rigid Mineral Fiber

ASTM C 612, Class 1.

2.4.2 Hot Equipment Insulation

For temperatures above 60 degrees F.

2.4.2.1 Omitted

2.4.2.2 Flexible Mineral Fiber

ASTM C 553, Type I, Class B-4 to 400 degrees F.

PART 3 EXECUTION

3.1 APPLICATION - GENERAL

3.1.1 Installation

Except as otherwise specified, material shall be installed in accordance with the manufacturer's written instructions. Insulation materials shall not be applied until tests specified in other sections of this specification are completed. Material such as rust, scale, dirt and moisture shall be removed from surfaces to receive insulation. Insulation shall be kept clean and dry. Insulation shall not be removed from its shipping containers until the day it is ready to use and shall be returned to like containers or equally protected from dirt and moisture at the end of each workday. Insulation that becomes dirty shall be thoroughly cleaned prior to use. If insulation becomes wet or if aforementioned cleaning does not restore the surfaces to like new condition, the insulation may be rejected, and if

rejected, shall be immediately removed from the jobsite. Joints shall be staggered on multilayer insulation. Mineral fiber thermal insulating cement shall be mixed with demineralized water when used on stainless steel surfaces. Insulation, jacketing and accessories shall be installed in accordance with MICA-01 standard plates except where modified herein or on the drawings.

3.1.2 Firestopping

Where pipes and ducts pass through fire walls, fire partitions, above grade floors, and fire rated chase walls, the penetration shall be sealed with firestopping materials as specified in Section 07270 FIRESTOPPING.

3.1.3 Omitted

3.1.4 Flexible Cellular Insulation

Flexible cellular insulation shall be installed with seams and joints sealed with a contact adhesive. Flexible cellular insulation shall not be used on surfaces greater than 200 degrees F. Insulation exposed to weather and not shown to have jacketing shall be protected with two coats of UV resistant finish as recommended by the manufacturer after the adhesive is dry.

3.1.5 Welding

No welding shall be done on piping, duct or equipment without written approval of the Contracting Officer. The capacitor discharge welding process may be used for securing metal fasteners to duct.

3.2 PIPE INSULATION INSTALLATION

3.2.1 Pipe Insulation

3.2.1.1 General

Pipe insulation shall be continuous and installed on fittings and appurtenances unless specified otherwise. Installation shall be with full length units of insulation and using a single cut piece to complete a run. Cut pieces or scraps abutting each other shall not be used.

3.2.1.2 Pipes Passing Through Sleeves

- a. Pipe insulation shall be continuous through the sleeve .
- b. An aluminum jacket with factory applied moisture barrier shall be provided over the insulation wherever penetrations require sealing.

3.2.1.3 Pipes Passing Through Hangers

- a. Insulation, whether hot or cold application, shall be continuous through hangers. All horizontal pipes 2 inches and smaller shall be supported on hangers with the addition of a Type 40 protection shield to protect the insulation in accordance with MSS SP-69. Whenever insulation shows signs of being compressed, or when the insulation or jacket shows visible signs of distortion at or near the support shield, insulation inserts as specified below for piping larger than 2 inches shall be installed.
- b. Horizontal pipes larger than 2 inches at 60 degrees F and above shall be supported on hangers with the addition of a Type 39 saddle in accordance with MSS SP-69.
- c. Horizontal pipes larger than 2 inches below 60 degrees F shall be supported on hangers with the addition of a Type 40 protection shield in accordance with MSS SP-69. An insulation insert of cellular glass or calcium silicate shall be installed above each shield. The insert shall cover not less than the bottom 180 degree arc of the pipe.

Inserts shall be the same thickness as the insulation, and shall extend 2 inches on each end beyond the protection shield. When insulation inserts are required per the above, and the insulation thickness is less than 1 inch, wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the weight of the pipe from crushing the insulation as an option to installing insulation inserts. The insulation jacket shall be continuous over the wooden dowel, wooden block, or insulation insert.

d. Vertical pipes shall be supported with either Type 8 or Type 42 riser clamps with the addition of two Type 40 protection shields in accordance with MSS SP-69 covering the 360 degree arc of the insulation. An insulation insert of cellular glass or calcium silicate shall be installed between each shield and the pipe. The insert shall cover the 360 degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 2 inches on each end beyond the protection shield. When insulation inserts are required per the above, and the insulation thickness is less than 1 inch, wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the hanger from crushing the insulation as an option instead of installing insulation inserts. The insulation jacket shall be continuous over the wooden dowel, wooden block, or insulation insert. The vertical weight of the pipe shall be supported with hangers located in a horizontal section of the pipe. When the pipe riser is longer than 30 feet, the weight of the pipe shall be additionally supported hangers in the vertical run of the pipe which are directly clamped to the pipe, penetrating the pipe insulation. These hangers shall be insulated and the insulation jacket sealed as indicated herein for anchors in a similar service.

e. Inserts shall be covered with a jacket material of the same appearance and quality as the adjoining pipe insulation jacket, shall overlap the adjoining pipe 1-1/2 inches, and shall be sealed as required for the pipe jacket. The jacket material used to cover inserts in flexible cellular insulation shall conform to ASTM C 921, Type 1, and is allowed to be of a different material than the adjoining insulation material.

3.2.1.4 Flexible Cellular Pipe Insulation

Flexible cellular pipe insulation shall be tubular form for pipe sizes 5 inches and less. Sweat fittings shall be insulated with miter-cut pieces the same size as on adjacent piping. Screwed fittings shall be insulated with sleeved fitting covers fabricated from miter-cut pieces and shall be overlapped and sealed to the adjacent pipe insulation.

3.2.2 Aboveground Cold Pipelines

The following shall be included for aboveground cold pipelines (minus 30 degrees to Plus 60 degrees F):

- a. Dual temperature water, i.e. HVAC hot/chilled water.

3.2.3 Insulation Thickness

Thickness of insulation shall be as indicated in TABLE I.

TABLE I
Pipe Size (Inches)

Service or Range of Temp (degrees F)	Run- outs*	1/4 to 1-1/2	1/4 to 1-1/4	1-1/2 to 3	3-1/2 to 5	6 to 10	11 to 24	25 to 33
60 to 35 (FC) (CG)	1/2	1	1	2	2	2	2	

(MF)	1	1	1-1/2	1-1/2	1-1/2	1-1/2
34 to 0 (CG)	2-1/2	2-1/2	2-1/2	3	3	3-1/2
(MF)	1-1/2	1-1/2	2	2	2-1/2	2-1/2
-1 to -30 (CG)	3	3	3	3-1/2	3-1/2	4
(MF)	1-1/2	2	2-1/2	2-1/2	3	3
Domestic (FC)	1/2	1/2	1/2			
Cold Water (CG)	1	1	1	1-1/2	1-1/2	1-1/2
and Interior (MF)	1/2	1/2	1/2	1	1	1
Roof Drain Lines (Horizontal portions only)						

NOTES:

CG - Cellular Glass

MF - Mineral Fiber

FC - Flexible Cellular

*When runouts to terminal units exceed 3.5 m, (12 feet,) the entire length of runout shall be insulated like the main feed pipe.

3.2.3.1 Jacket for Fibrous and Cellular Glass Insulated Pipe

Insulation shall be covered with a factory applied vapor barrier jacket or field applied seal welded PVC jacket. Insulation inside the building shown to be protected with an aluminum jacket shall have the insulation and vapor barrier jacket installed as specified herein. The aluminum jacket shall be installed as specified for piping exposed to weather, except sealing of the laps of the aluminum jacket is not required.

3.2.3.2 Insulation for Straight Runs (Fibrous and Cellular Glass)

a. Insulation shall be applied to the pipe with joints tightly butted. The ends of fibrous insulation shall be sealed off with vapor barrier coating at intervals not to exceed 15 feet.

b. Longitudinal laps of the jacket material shall overlap not less than 1-1/2 inches. Butt strips 3 inches wide shall be provided for circumferential joints.

c. Laps and butt strips shall be secured with adhesive and stapled on 4 inch centers if not factory self-sealing.

d. Factory self-sealing lap systems may be used when the ambient temperature is between 40 degrees F to 120 degrees F during installation. The lap system shall be installed in accordance with manufacturer's recommendations. Stapler shall be used only if specifically recommended by the manufacturer. Where gaps occur, the section shall be replaced or the gap repaired by applying adhesive under the lap and then stapling.

e. All Staples, including those used to repair factory self-seal lap systems, shall be coated with a vapor barrier coating. All seams, except those on factory self-seal systems shall be coated with vapor barrier coating.

f. Breaks and punctures in the jacket material shall be patched by wrapping a strip of jacket material around the pipe and securing it with adhesive, stapling, and coated with vapor barrier coating. The patch shall extend not less than 1-1/2 inches past the break.

g. At penetrations such as thermometers, the voids in the insulation shall be filled and sealed with vapor barrier coating.

3.2.3.3 Insulation for Fittings and Accessories

- a. Pipe insulation shall have ends thoroughly coated with a vapor barrier coating not more than 6 inches from each flange, union, valve, anchor, or fitting in all directions.
- b. Insulation may be premolded or segmented. Insulation of the same thickness and conductivity as the adjoining pipe insulation shall be used. If nesting size insulation is used, the insulation should be overlapped 2 inches or one pipe diameter. Loose fill mineral fiber or insulating cement shall be used to fill the voids. Insulation for elbows less than 3 inch size shall be premolded. Insulation for elbows 3 inch size and larger shall be either premolded or segmented. Elbows insulated using segments shall not have less than 3 segments per elbow. Insulation may be secured by wire or tape until finish is applied.
- c. Upon completion of installation of insulation on flanges, unions, valves, anchors, fittings and accessories, terminations and insulation not protected by factory vapor barrier jackets or PVC fitting covers shall be protected with two coats of vapor barrier coating with a minimum total thickness of 1/16th inch, applied with glass tape embedded between coats. Tape seams shall overlap 1 inch. The coating shall extend out onto the adjoining pipe insulation 2 inches.
- d. Anchors attached directly to the pipe shall be insulated for a sufficient distance to prevent condensation but not less than 6 inches from the insulation surface.
- e. Flexible connections at pumps and other equipment shall be insulated with 1/2 inch flexible cellular insulation, unless otherwise indicated.
- f. Insulation shall be marked showing the location of unions, strainers, and check valves.

3.2.3.4 Optional PVC Fitting Covers

At the option of the Contractor, premolded, one or two piece PVC fitting covers may be used in lieu of the vapor barrier and embedded glass tape. Factory premolded insulation segments shall be used under the fitting covers for elbows. Insulation segments shall be the same thickness as adjoining pipe insulation and the insulation shall be protected with one coat of vapor barrier coating under the PVC cover. The covers shall be secured by PVC vapor barrier tape, adhesive, seal-welding or with tacks made for securing PVC covers. Seams in the cover, and tacks and laps to adjoining pipe insulation jacket, shall be sealed with vapor barrier tape to ensure that the assembly has a continuous vapor seal. Factory or fieldcut blanket insulation shall not be used on pipe below 60 degrees F.

3.2.4 Omitted

3.2.5 Piping Exposed to Weather

Piping exposed to weather shall be insulated and jacketed as specified for the applicable service inside the building. After this procedure, an aluminum jacket shall be applied. PVC jacketing requires no factory applied jacket beneath it.

3.2.5.1 Aluminum Jacket

The jacket for hot piping may be factory applied. The jacket shall overlap not less than 2 inches at longitudinal and circumferential joints and shall be secured with bands at not more than 12 inch centers. Longitudinal joints shall be overlapped down to shed water and located at 4 or 8 o'clock positions. Joints on piping 60 degrees F and below shall be sealed with caulking while overlapping to prevent moisture penetration. Where jacketing on piping 60 degrees F and below abuts an uninsulated surface, joints shall be caulked to prevent moisture penetration. Joints on piping above 60 degrees F shall be sealed with a moisture barrier.

3.2.5.2 Insulation for Fittings

Flanges, unions, valves, fittings, and accessories shall be insulated and finished as specified for the applicable service. Two coats of an emulsion type weatherproof mastic recommended by the insulation manufacturer shall be

applied with glass tape embedded between coats. Tape overlaps shall be not less than 1 inch and the adjoining aluminum jacket not less than 2 inches. Factory preformed aluminum jackets may be used in lieu of the above. Molded PVC fitting covers shall be used with PVC lagging and adhesive welded moisture tight.

3.2.5.3 PVC Lagging

PVC lagging shall be ultraviolet resistant and adhesive welded vapor tight with manufacturer's recommended adhesive. Installation shall include provision for thermal expansion.

3.2.6 Omitted

3.3 DUCT INSULATION INSTALLATION

Except for oven hood exhaust duct insulation, corner angles shall be installed on external corners of insulation on ductwork in exposed finished spaces before covering with jacket.

3.3.1 Insulation and Vapor Barrier for Cold Air Duct

Insulation and Vapor Barrier for Cold Air Duct (60 degrees F): Ducts and associated equipment shall be insulated to a thickness of 2 inches. The following shall be insulated:

- a. Supply ducts.
- b. Return air ducts.
- c. Fresh air intake ducts.
- d. Mixing boxes (field-insulated).

Insulation for rectangular ducts shall be flexible type where concealed, minimum density 3/4 pcf and rigid type where exposed, minimum density 3 pcf. Insulation for round ducts shall be flexible type, minimum density 3/4 pcf with a factory Type I jacket. Fibrous and cellular glass insulation for exposed ducts shall be provided with either a white, paintable, factory-applied Type I jacket or a vapor barrier jacket coating finish as specified. Fibrous and cellular glass insulation on concealed duct shall be provided with a factory-applied Type I vapor barrier jacket. Vapor barrier coating finish where indicated to be used shall be accomplished by applying two coats of vapor barrier coating with a layer of glass cloth embedded between the coats. The total dry film thickness shall be approximately 1/16 inch. Duct insulation shall be continuous through sleeves and prepared openings except fire wall penetrations. Duct insulation terminating at fire dampers, shall be continuous over the damper collar and retaining angle of fire dampers, which are exposed to unconditioned air and which may be prone to condensate formation. Duct insulation and vapor barrier shall cover the collar, neck, and any uninsulated surfaces of diffusers, registers and grills. Vapor barrier materials shall be applied to form a complete unbroken vapor seal over the insulation.

3.3.1.1 Installation on Concealed Duct

- a. For rectangular, oval or round ducts, insulation shall be attached by applying Class 2 adhesive around the entire perimeter of the duct in 6 inch wide strips on 12 inch centers.
- b. For rectangular and oval ducts, 24 inches and larger insulation shall be additionally secured to bottom of ducts by the use of mechanical fasteners. Fasteners shall be spaced on 18 inch centers and not more than 18 inches from duct corners.
- c. For rectangular, oval and round ducts, mechanical fasteners shall be provided on sides of duct risers for all duct sizes. Fasteners shall be spaced on 18 inch centers and not more than 18 inches from duct corners.

d. Insulation shall be impaled on the mechanical fasteners where used and shall be pressed thoroughly into the adhesive. Care shall be taken to ensure vapor barrier jacket joints overlap 2 inches. The insulation shall not be compressed to a thickness less than that specified. Insulation shall be carried over standing seams and trapeze-type duct hanger.

e. Self-locking washers shall be installed where mechanical fasteners are used. The pin shall be trimmed back and bent over.

f. Jacket overlaps shall be secured under the overlap with Class 2 adhesive and stapled on 4 inch centers. Staples and seams shall be coated with a brush coat of vapor barrier coating.

g. Breaks in the jacket material shall be covered with patches of the same material as the vapor barrier. The patches shall extend not less than 2 inches beyond the break or penetration in all directions and shall be secured with Class 2 adhesive and staples. Staples and joints shall be sealed with a brush coat of vapor barrier coating.

h. At jacket penetrations such as hangers thermometers and damper operating rods, voids in the insulation shall be filled and the penetration sealed with a brush coat of vapor barrier coating.

i. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor barrier coating finish. The coating shall overlap the adjoining insulation and uninsulated surface 2 inches. Pin puncture coatings shall extend 2 inches from the puncture in all directions.

j. Where insulation standoff brackets occur, insulation shall be extended under the bracket and the jacket terminated at the bracket.

3.3.2 Omitted

3.3.3 Ducts Handling Air for Dual Purpose

For air handling ducts for dual purpose (below and above 60 degrees F,) ducts shall be insulated as specified for cold air duct.

3.3.4 Duct Test Holes

After duct systems have been tested, adjusted, and balanced, breaks in the insulation and jacket shall be repaired in accordance with the applicable section of this specification for the type of duct insulation to be repaired.

3.4 EQUIPMENT INSULATION INSTALLATION

3.4.1 General

Removable insulation sections shall be provided to cover parts of equipment which must be opened periodically for maintenance including vessel covers, fasteners, flanges and accessories.

3.4.2 Insulation for Cold Equipment

Cold equipment below 60 degrees F: Insulation shall be furnished on equipment handling media below 60 degrees F including the following:

- a. Air handling equipment parts that are not factory insulated (i.e. damper sections).

3.4.2.1 Insulation Type

Insulation shall be suitable for the temperature encountered. Thicknesses shall be as follows:

a. Equipment Handling Media Between 35 and 60 degrees F: 1-1/2 inch thick mineral fiber, 2 inch thick cellular glass, or 1-1/2 inch thick flexible cellular.

3.4.2.2 Omitted

3.4.2.3 Other Equipment

a. Insulation shall be formed or fabricated to fit the equipment. To ensure a tight fit on round equipment, edges shall be beveled and joints shall be tightly butted and staggered.

b. Insulation shall be secured in place with bands or wires at intervals as recommended by the manufacturer but not more than 12 inch centers except flexible cellular which shall be adhered. Insulation corners shall be protected under wires and bands with suitable corner angles.

c. Cellular glass insulation shall be set in a coating of bedding compound, and joints shall be sealed with bedding compound as recommended by the manufacturer. Mineral fiber insulation joints shall be filled with finishing cement.

d. Exposed insulation corners shall be protected with corner angles.

3.4.2.4 Vapor Barrier

Upon completion of installation of insulation, penetrations shall be caulked. Two coats of vapor barrier coating shall be applied over insulation, including removable sections, with a layer of glass cloth embedded between the coats. The total dry thickness of the finish shall be 1/16 inch. Caulking shall be applied to parting line between equipment and removable section insulation.

3.4.3 Omitted

3.4.4 Equipment Handling Dual Temperature Media

Below and above 60 degrees F: Equipment handling dual temperature media shall be insulated as specified for cold equipment.

3.4.5 Omitted

3.4.5.1 Installation

Equipment exposed to weather shall be insulated and finished in accordance with the requirements for ducts exposed to weather in paragraph DUCT INSULATION INSTALLATION.

(END OF SECTION)

SECTION 15400**PLUMBING, GENERAL PURPOSE****PART 1 GENERAL****1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI SAMA Z236.1	(1983) General Purpose Lab for Liquid-in-Glass Thermometers - General Purpose Laboratory Use
ANSI Z21.22	(1986; Z21.22a) Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 47	(1990) Ferritic Malleable Iron Castings
ASTM A 53	(1993a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 74	(1994) Cast Iron Soil Pipe and Fittings
ASTM A 536	(1984; R 1993) Ductile Iron Castings
ASTM A 733	(1993) Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM A 888	(1994) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
ASTM B 32	(1993) Solder Metal
ASTM B 42	(1993) Seamless Copper Pipe, Standard Sizes
ASTM B 43	(1991) Seamless Red Brass Pipe, Standard Sizes
ASTM B 75	(1993) Seamless Copper Tube
ASTM B 88	(1993a) Seamless Copper Water Tube
ASTM B 152	(1993a) Copper Sheet, Strip, Plate, and Rolled Bar
ASTM B 306	(1992) Copper Drainage Tube (DWV)
ASTM B 370	(1992) Copper Sheet and Strip for Building Construction
ASTM B 584	(1993b) Copper Alloy Sand Castings for General Applications
ASTM B 641	(1993) Seamless and Welded Copper Distribution Tube (Type D)

ASTM B 813	Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube
ASTM C 564	(1993) Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C 920	(1987) Elastomeric Joint Sealants
ASTM D 2822	(1991) Asphalt Roof Cement
ASTM D 3139	(1989) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D 3212	(1992) Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 3308	(1991a) PTFE Resin Skived Tape
ASTM D 3311	(1992) Drain, Waste, and Vent (DWV) Plastic Fittings Patterns
ASTM F 409	(1993) Thermoplastic Accessible and Replaceable Plastic Tube and Tubular Fittings
ASTM F 477	(1993) Elastomeric Seals (Gaskets) for Joining Plastic Pipe

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A112.1.2	(1991) Air Gaps in Plumbing Systems
ASME A112.6.1M	(1988) Supports for Off-the-Floor Plumbing Fixtures for Public Use
ASME A112.19.2M	(1990) Vitreous China Plumbing Fixtures
ASME A112.21.1M	(1991) Floor Drains
ASME A112.36.2M	(1991) Cleanouts
ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)
ASME B16.3	(1992) Malleable Iron Threaded Fittings
ASME B16.4	(1992) Cast Iron Threaded Fittings
ASME B16.12	(1991) Cast Iron Threaded Drainage Fittings
ASME B16.15	(1985) Cast Bronze Threaded Fittings Classes 125 and 250
ASME B16.18	(1984) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(1989) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.23	(1992; Errata Jan 1994) Cast Copper Alloy Solder Joint Drainage Fittings - DWV
ASME B16.24	(1991; Errata Jun 91) Cast Copper Alloy Pipe Flanges, Class 150, 300, 400, 600, 900, 1500 and 2500, and Flanged Fittings, Class 150 and 300

ASME B16.29	(1986) Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV
ASME B16.39	(1986) Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300
ASME B31.5	(1992; B31.5a) Refrigeration Piping
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element
ASME CSD-1	(1992; CSD-1a; CSD-1b) Controls and Safety Devices for Automatically Fired Boilers

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1001	(1990) Pipe Applied Atmospheric Type Vacuum Breakers
ASSE 1005	(1993) Water Heater Drain Valves - 3/4-Inch Iron Pipe Size
ASSE 1011	(1993) Hose Connection Vacuum Breakers
ASSE 1012	(1993) Backflow Preventers with Intermediate Atmospheric Vent
ASSE 1013	(1993) Reduced Pressure Principle Backflow Preventers
ASSE 1018	(1986) Trap Seal Primer Valves Water Supply Fed
ASSE 1037	(1990) Pressurized Flushing Devices (Flushometers) for Plumbing Fixtures

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA-01	(1992) Standard Methods for the Examination of Water and Wastewater
AWWA B300	(1992) Hypochlorites
AWWA B301	(1992) Liquid Chlorine
AWWA C606	(1987) Grooved and Shouldered Joints
AWWA M20	(1973) Manual: Water Chlorination Principles and Practices

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8	(1992) Filler Metals for Brazing and Braze Welding
AWS B2.2	(1991) Brazing Procedure and Performance Qualification

CAST IRON SOIL PIPE INSTITUTE (CISPI)

CISPI 301	(1990) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
CISPI HSN	(1985) Neoprene Rubber Gaskets for Hub and Spigot Cast Iron Soil Pipe and Fittings

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-238 (Rev B) Seat, Water Closet

COPPER DEVELOPMENT ASSOCIATION (CDA)

CDA 404/O-RR (1992) Copper Tube for Plumbing, Heating, Air Conditioning and Refrigeration

COUNCIL OF AMERICAN BUILDING OFFICIALS (CABO)

CABO A117.1 (1992; Errata Jun 1993) American National Standard for Accessible and Usable buildings and Facilities

FEDERAL SPECIFICATIONS (FS)

FS QQ-B-654 (Rev A; Am 1; Notice 1) Brazing Alloys, Silver

FS TT-P-1536 (Rev A) Plumbing Fixture Setting Compound

FS WW-C-440 (Rev B; Am 2) Clamps, Hose, (Low-Pressure)

FS WW-P-541/GEN (Rev E; Am 1) Plumbing Fixtures

FS WW-P-541/4 (Rev B; Am 1) Plumbing Fixtures (Lavatories)

FS WW-P-541/5 (Rev B; Am 1) Plumbing Fixtures (Sinks, Kitchen, Service, and Laundry Trays)

FS WW-U-516 (Rev B; Notice 1) Unions, Brass or Bronze, Threaded Pipe Connections and Solder-Joint Tube Connections

FS WW-V-35 (Rev C) Valve, Ball

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCHR)

FCCHR-01 (1993) Manual of Cross-Connection Control

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-44 (1991) Steel Pipe Line Flanges

MSS SP-58 (1993) Pipe Hangers and Supports - Materials, Design and Manufacture

MSS SP-67 (1990) Butterfly Valves

MSS SP-69 (1991) Pipe Hangers and Supports - Selection and Application

MSS SP-73 (1991) Brazing Joints for Copper and Copper Alloy Pressure Fittings

MSS SP-80 (1987) Bronze Gate, Globe, Angle and Check Valves

MSS SP-83 (1987) Steel Pipe Unions Socket-Welding and Threaded

NATIONAL ASSOCIATION OF PLUMBING-HEATING-COOLING CONTRACTORS (NAPHCC)

NAPHCC-01 (1993; Supple 1994) National Standard Plumbing Code (Non-Illustrated Edition)

NAPHCC-02 (1993) National Standard Plumbing Code Illustrated Edition

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A (1993) Installation of Air Conditioning and Ventilating Systems

PLASTIC PIPE AND FITTINGS ASSOCIATION (PPFA)

PPFA-01 (1991) Plastic Pipe in Fire Resistive Construction

NATIONAL SANITATION FOUNDATION FOUNDATION (nsf)
NSF Plumbing Material Standards

PLUMBING AND DRAINAGE INSTITUTE (PDI)

PDI WH 201 (1992) Water Hammer Arresters

1.2 STANDARD PRODUCTS

Specified materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products. Specified equipment shall essentially duplicate equipment that has performed satisfactorily at least two years prior to bid opening.

1.3 ELECTRICAL WORK

Motors, motor controllers and motor efficiencies shall conform to the requirements of Section 16415 ELECTRICAL WORK. Electrical motor-driven equipment specified herein shall be provided complete with motors. Equipment shall be rated at 60 Hz, single phase, ac unless otherwise indicated. Where a motor controller is not provided in a motor-control center on the electrical drawings, a motor controller shall be as indicated. Motor controllers shall be provided complete with properly sized thermal-overload protection in each ungrounded conductor, auxiliary contact, and other equipment, at the specified capacity, and including an allowable service factor.

1.4 SUBMITTALS

The following shall be submitted for Government approval:

1.4.1 Data

1.4.1.1 Welding

A copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators.

1.4.2 Reports

1.4.2.1 Tests, Flushing and Sterilization

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, completion and testing of the installed system. Each test report shall indicate the final position of controls.

1.4.3 Certificates

1.4.3.1 Materials and Equipment

Where materials or equipment are specified to comply with requirements of AGA, or ASME, proof of such compliance. The label or listing of the specified agency will be acceptable evidence. In lieu of the label or listing, a written certificate may be submitted from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency. Where equipment is specified to conform to requirements of the ASME Boiler and Pressure Vessel Code, the design, fabrication, and installation shall conform to the code.

1.5 REGULATORY REQUIREMENTS

1.5.1 Plumbing

Plumbing work shall be in accordance with NAPHCC-01, unless otherwise stated and installed in accordance with NAPHCC-02.

1.6 PROJECT/SITE CONDITIONS

The Contractor shall become familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

PART 2 PRODUCTS

2.1 MATERIALS

Materials for various services shall be in accordance with TABLES I and II. Pipe schedules shall be selected based on service requirements. Pipe fittings shall be compatible with the applicable pipe materials. Plastic pipe, fittings, and solvent cement shall meet NSF Std 14 and shall be NSF listed for the service intended. Pipe threads (except dry seal) shall conform to ASME B1.20.1. Grooved pipe couplings and fittings shall be from the same manufacturer. Material or equipment containing lead shall not be used in any potable water system. Hubless cast-iron soil pipe shall not be installed under concrete floor slabs or in crawl spaces below kitchen floors. Plastic pipe shall not be installed under concrete floor slabs, or in air plenums.

2.1.1 Pipe Joint Materials

Grooved pipe shall not be used under ground. Joints and gasket materials shall conform to the following:

- a. Coupling for Cast-Iron Pipe: ASTM A 74, AWWA C606.
- b. Flange Gaskets: Gaskets shall be made of non-asbestos material in accordance with ASME B16.21. Gaskets shall be flat, 1/16 inch thick, and contain Aramid fibers bonded with Styrene Butadiene Rubber (SBR) or Nitro Butadiene Rubber (NBR). Gaskets shall be the full face or self centering flat ring type. Gaskets used for hydrocarbon service shall be bonded with NBR.
- c. Neoprene Gaskets for Hub and Cast-Iron Pipe and Fittings: CISPI HSN.
- d. Brazing Material: Brazing material shall conform to AWS A5.8, BCuP-5.
- e. Brazing Flux: Flux shall be in paste or liquid form appropriate for use with brazing material. Flux shall be as follows: lead-free; have a 100 percent flushable residue; contain slightly acidic reagents; contain potassium borides; and contain fluorides. Silver brazing materials shall be in accordance with FS QQ-B-654.
- f. Solder Material: Solder metal shall conform to ASTM B 32 95-5 tin-antimony.

- g. Solder Flux: Flux shall be liquid form, non-corrosive, and conform to ASTM B 813, Standard Test 1.
- h. PTFE Tape: PTFE Tape, for use with Threaded Metal or Plastic Pipe, ASTM D 3308.
- I. Rubber Gaskets for Cast-Iron Soil-Pipe and Fittings: ASTM C 564.
- j. Flexible Elastomeric Seals: ASTM D 3139, ASTM D 3212 or ASTM F 477.

2.1.2 Miscellaneous Materials

Miscellaneous materials shall conform to the following:

- a. Water Hammer Arrestor: PDI WH 201.
- b. Copper, Sheet and Strip for Building Construction: ASTM B 370.
- c. Asphalt Roof Cement: ASTM D 2822.
- d. Hose Clamps: FS WW-C-440.
- e. Supports for Off-The-Floor Plumbing Fixtures: ASME A112.6.1M.
- f. Metallic Cleanouts: ASME A112.36.2M.
- g. Plumbing Fixture Setting Compound: FS TT-P-1536, Type II.
- h. Hypochlorites: AWWA B300.
- i. Liquid Chlorine: AWWA B301.
- j. Gauges - Pressure and Vacuum Indicating Dial Type - Elastic Element: ASME B40.1.
- k. Thermometers: ANSI SAMA Z236.1 .

2.1.3 Pipe Insulation Material

Insulation shall be as specified in Section 15250 THERMAL INSULATION FOR PIPE.

2.2 PIPE HANGERS, INSERTS, AND SUPPORTS

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69.

2.3 VALVES

Valves shall be provided on supplies to equipment and fixtures. Valves 2-1/2 inches and smaller shall be bronze with threaded bodies for pipe and solder-type connections for tubing. Valves 3 inches and larger shall have flanged iron bodies and bronze trim. Pressure ratings shall be based upon the application. Grooved end valves may be provided if the manufacturer certifies that the valves meet the performance requirements of applicable MSS standard. Valves shall conform to the following standards:

Description	Standard
_____	_____

Butterfly Valves	MSS SP-67
Ball Valves	FS WW-V-35
Bronze Gate, Globe, Angle, and Check Valves	MSS SP-80
Vacuum Relief Valves	ASSE 1001
Water Heater Drain Valves	ASSE 1005
Trap Seal Primer Valves	ASSE 1018
Temperature and Pressure Relief Valves for Hot Water Supply Systems	ANSI Z21.22
Temperature and Pressure Relief Valves for Automatically Fired Hot Water Boilers	ASME CSD-1 Safety Code No., Part CW, Article 5

2.3.1 Wall Hydrants (Hose Bib: HB)

Wall hydrants shall have vacuum-breaker backflow preventer and shall have a nickel-brass or nickel-bronze wall plate or flange with nozzle and detachable key handle. A brass or bronze operating rod shall be provided within a galvanized iron casing of sufficient length to extend through the wall so that the valve is inside the building, and the portion of the hydrant between the outlet and valve is self-draining. A brass or bronze valve with coupling and union elbow having metal-to-metal seat shall be provided. Valve rod and seat washer shall be removable through the face of the hydrant. The hydrant shall have 3/4 inch exposed hose thread on spout and 3/4 inch male pipe thread on inlet.

2.3.2 Relief Valves

Water heaters and hot water storage tanks shall have a combination pressure and temperature (P&T) relief valve. The pressure relief element of a P&T relief valve shall have adequate capacity to prevent excessive pressure buildup in the system when the system is operating at the maximum rate of heat input. The temperature element of a P&T relief valve shall have a relieving capacity which is at least equal to the total input of the heaters when operating at their maximum capacity. Relief valves shall be rated according to ANSI Z21.22. Relief valves for systems where the maximum rate of heat input is less than 200,000 Btuh shall have 3/4 inch minimum inlets, and 3/4 inch outlets. Relief valves for systems where the maximum rate of heat input is greater than 200,000 Btuh shall have 1 inch minimum inlets, and 1 inch outlets. The discharge pipe from the relief valve shall be the size of the valve outlet.

2.4 FIXTURES

Fixtures shall be water conservation type, in accordance with NAPHCC-01. Fixtures for use by the physically handicapped shall be in accordance with CABO A117.1. Vitreous china, nonabsorbent, hard-burned, and vitrified throughout the body shall be provided where indicated. Porcelain enameled ware shall have specially selected, clear white, acid-resisting enamel coating evenly applied on surfaces. No fixture will be accepted that shows cracks, crazes, blisters, thin spots, or other flaws. Fixtures shall be equipped with appurtenances such as traps, faucets, stop valves, and drain fittings. Each fixture and piece of equipment requiring connections to the drainage system shall be equipped with a trap. Brass expansion or toggle bolts capped with acorn nuts shall be provided for supports, and polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Fixtures with the supply discharge below the rim shall be equipped with backflow preventers. Internal parts of flush and/or flushometer valves, pop-up stoppers of lavatory waste drains, and pop-up stoppers and overflow tees may contain acetal resin, fluorocarbon, nylon, acrylonitrile-butadiene-styrene (ABS) or other plastic material, if the material has provided satisfactory service under actual commercial or industrial operating conditions for not less than 2 years.

Plastic in contact with hot water shall be suitable for 180 degrees F water temperature. Plumbing fixtures shall generally be in accordance with FS WW-P-541/GEN, and shall be as indicated in paragraph PLUMBING FIXTURE SCHEDULE.

2.4.1 Lavatories

Solid surface, drop-in, self rimming type shall be used as scheduled.

2.5 BACKFLOW PREVENTERS

Reduced pressure principle assemblies, double check valve assemblies, atmospheric (nonpressure) type vacuum breakers, and pressure type vacuum breakers shall be tested, approved, and listed in accordance with FCCHR-01. Backflow preventers with intermediate atmospheric vent shall conform to ASSE 1012. Reduced pressure principle backflow preventers shall conform to ASSE 1013. Hose connection vacuum breakers shall conform to ASSE 1011. Pipe applied atmospheric type vacuum breakers shall conform to ASSE 1001. Air gaps in plumbing systems shall conform to ASME A112.1.2.

2.6 DRAINS

2.6.1 Floor Drains (FD)

Floor drains shall consist of a galvanized body, integral seepage pan, and adjustable perforated or slotted chromium-plated bronze, nickel-bronze, or nickel-brass strainer, consisting of grate and threaded collar. Floor drains shall be cast iron except where metallic waterproofing membrane is installed. Drains shall be of double drainage pattern for embedding in the floor construction. The seepage pan shall have weep holes or channels for drainage to the drainpipe. The strainer shall be adjustable to floor thickness. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or waterproofing membrane shall be provided when required. Drains shall be provided with threaded or caulked connection. In lieu of a caulked joint between the drain outlet and waste pipe, a neoprene rubber gasket conforming to ASTM C 564 may be installed, provided that the drain is specifically designed for the rubber gasket compression type joint. Floor and shower drains shall conform to ASME A112.21.1M.

2.6.2 Sight Drains (SD)

Sight drains shall consist of body, integral seepage pan, and adjustable strainer with perforated or slotted grate and funnel extension. The strainer shall have a threaded collar to permit adjustment to floor thickness. Drains shall be of double drainage pattern suitable for embedding in the floor construction. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or membrane shall be provided for other than concrete construction. Drains shall have a galvanized heavy cast-iron body and seepage pan and chromium-plated bronze, nickel-bronze, or nickel-brass strainer and funnel combination. Drains shall be provided with threaded or caulked connection and with a separate cast-iron "P" trap, unless otherwise indicated. Drains shall be circular, unless otherwise indicated. The funnel shall be securely mounted over an opening in the center of the strainer. Minimum dimensions shall be as follows:

Area of strainer and collar	36 square inches
Height of funnel	3-3/4 inches
Diameter of lower portion of funnel	2 inches
Diameter of upper portion of funnel	4 inches

2.7 TRAPS

Unless otherwise specified, traps shall be plastic per ASTM F 409 or copper-alloy adjustable tube type with slip joint inlet and swivel. Traps shall be without a cleanout. Tubes shall be copper alloy with walls not less than 0.032 inch thick within commercial tolerances, except on the outside of bends where the thickness may be reduced slightly in manufacture by usual commercial methods. Inlets shall have rubber washer and copper alloy nuts for slip joints above the discharge level. Swivel joints shall be below the discharge level and shall be of metal-to-metal or metal-to-plastic type as required for the application. Nuts shall have flats for wrench grip. Outlets shall have internal pipe thread, except that when required for the application, the outlets shall have sockets for solder-joint connections. The depth of the water seal shall be not less than 2 inches. The interior diameter shall be not more than 1/8 inch over or under the nominal size, and interior surfaces shall be reasonably smooth throughout. A copper alloy "P" trap assembly consisting of an adjustable "P" trap and threaded trap wall nipple with cast brass wall flange shall be provided for lavatories. The assembly shall be a standard manufactured unit and may have a rubber-gasketed swivel joint.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Neither hubless cast-iron nor plastic pipe shall be installed under concrete floor slabs. Piping located in air plenums shall conform to NFPA 90A requirements. Unprotected plastic pipe shall not be installed in air plenum. Installation of plastic pipe where in compliance with NFPA may be installed in accordance with PPFA-01. The plumbing system shall be installed complete with necessary fixtures, fittings, traps, valves, and accessories. Water and drainage piping shall be extended 5 feet outside the building, unless otherwise indicated. A backflow preventer and drain shall be installed on the water service line inside the building approximately 6 inches above the floor from point of entry. Piping shall be connected to the exterior service lines or capped or plugged if the exterior service is not in place. Sewer and water pipes shall be laid in separate trenches, except when otherwise shown. Exterior underground utilities shall be at least 12 inches below the finish grade or as indicated on the drawings. If trenches are closed or the pipes are otherwise covered before being connected to the service lines, the location of the end of each plumbing utility shall be marked with a stake or other acceptable means. Valves shall be installed with control no lower than the valve body.

3.1.1 Water Pipe, Fittings, and Connections

3.1.1.1 Utilities

The piping shall be extended to fixtures, outlets, and equipment. The hot-water and cold-water piping system shall be arranged and installed to permit draining. The supply line to each item of equipment or fixture, except faucets, flush valves, or other control valves which are supplied with integral stops, shall be equipped with a shutoff valve to enable isolation of the item for repair and maintenance without interfering with operation of other equipment or fixtures. Supply piping to fixtures, faucets, hydrants, and flushing devices shall be anchored to prevent movement.

3.1.1.2 Cutting and Repairing

The work shall be carefully laid out in advance, and unnecessary cutting of construction shall be avoided. Damage to building, piping, wiring, or equipment as a result of cutting shall be repaired by mechanics skilled in the trade involved.

3.1.1.3 Protection of Fixtures, Materials, and Equipment

Pipe openings shall be closed with caps or plugs during installation. Fixtures and equipment shall be tightly covered and protected against dirt, water, chemicals, and mechanical injury. Upon completion of the work, the fixtures, materials, and equipment shall be thoroughly cleaned, adjusted, and operated. Safety guards shall be provided for exposed rotating equipment.

3.1.1.4 Mains, Branches, and Runouts

Piping shall be installed as indicated. Pipe shall be accurately cut and worked into place without springing or forcing. Structural portions of the building shall not be weakened. Aboveground piping shall run parallel with the lines of the building, unless otherwise indicated. Branch pipes from service lines may be taken from top, bottom, or side of main, using crossover fittings required by structural or installation conditions. Supply pipes, valves, and fittings shall be kept a sufficient distance from other work and other services to permit not less than 1/2 inch between finished covering on the different services. Bare and insulated water lines shall not bear directly against building structural elements so as to transmit sound to the structure or to prevent flexible movement of the lines. Water pipe shall not be buried in or under floors. Changes in pipe sizes shall be made with reducing fittings. Use of bushings will not be permitted except for use in situations in which standard factory fabricated components are furnished to accommodate specific excepted installation practice. Change in direction shall be made with fittings, except that bending of pipe 4 inches and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The center-line radius of bends shall be not less than six diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be acceptable.

3.1.1.5 Commercial-Type Water Hammer Arresters

Commercial-type water hammer arresters shall be provided on hot- and cold-water supplies and shall be located as generally indicated, with precise location and sizing to be in accordance with PDI WH 201. Water hammer arresters, where concealed, shall be accessible by means of access doors or removable panels. Commercial-type water hammer arresters shall conform to PDI WH 201. Vertical capped pipe columns will not be permitted.

3.1.2 Joints

Installation of pipe and fittings shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Joints shall be made up with fittings of compatible material and made for the specific purpose intended.

3.1.2.1 Threaded

Threaded joints shall have American Standard taper pipe threads conforming to ASME B1.20.1. Only male pipe threads shall be coated with graphite or with an approved graphite compound, or with an inert filler and oil, or shall have a polytetrafluoroethylene tape applied.

3.1.2.2 Mechanical Couplings

Grooved mechanical joints shall be prepared according to the coupling manufacturer's instructions. Pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, or narrow-land micrometer. Groove width and dimension of groove from end of the pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations.

3.1.2.3 Union and Flanged

Unions, flanges and mechanical couplings shall not be concealed in walls, ceilings, or partitions. Unions shall be used on pipe sizes 2-1/2 inches and smaller; flanges shall be used on pipe sizes 3 inches and larger.

3.1.2.4 Cast Iron Soil, Waste and Vent Pipe

Bell and spigot compression and hubless gasketed clamp joints for soil, waste and vent piping shall be installed per the manufacturer's recommendations.

3.1.2.5 Copper Tube and Pipe

The tube or fittings shall not be annealed when making connections. Connections shall be made with a multiflame torch.

a. **Brazed.** Brazed joints shall be made in conformance with AWS B2.2, MSS SP-73, and CDA 404/O-RR with flux and are acceptable for line sizes. Copper to copper joints shall include the use of copper-phosphorus or copper-phosphorus-silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorus, copper-phosphorus-silver or a silver brazing filler metal.

b. **Soldered.** Soldered joints shall be made with flux and are only acceptable for lines 2 inches and smaller. Soldered joints shall conform to ASME B31.5 and CDA 404/O-RR.

c. **Copper Tube Extracted Joint.** An extracted mechanical joint may be made in copper tube. Joint shall be produced with an appropriate tool by drilling a pilot hole and drawing out the tube surface to form a collar having a minimum height of three times the thickness of the tube wall. To prevent the branch tube from being inserted beyond the depth of the extracted joint, dimpled depth stops shall be provided. Branch tube shall be notched for proper penetration into fitting to ensure a free flow joint. Extracted joints shall be brazed in accordance with NAPHCC-01 using B-Cup series filler metal in accordance with MSS SP-73. Soldered extracted joints will not be permitted.

3.1.3 Dissimilar Pipe Materials

Connections between ferrous and non-ferrous copper pipe shall be made with dielectric unions or flange waterways. Connecting joints between plastic and metallic pipe shall be made with transition fitting for the specific purpose.

3.1.4 Pipe Sleeves and Flashing

Pipe sleeves shall be furnished and set in their proper and permanent location.

3.1.4.1 Sleeve Requirements

Pipes passing through concrete or masonry walls or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves are not required for cast-iron soil pipe passing through concrete slab on grade, except where penetrating a membrane waterproof floor. A modular mechanical type sealing assembly may be installed in lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve. The seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve with corrosion-protected carbon steel bolts, nuts, and pressure plates. The links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe and sleeve involved. Sleeves shall not be installed in structural members, except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective floor, or roof, and shall be cut flush with each surface, except for special circumstances. Pipe sleeves passing through floors in wet areas such as mechanical equipment rooms, lavatories, kitchens, and other plumbing fixture areas shall extend a minimum of 4 inches above the finished floor. Unless otherwise indicated, sleeves shall be of a size to provide a minimum of 1/4 inch clearance between bare pipe and inside of sleeve or between jacket over insulation and sleeves. Sleeves in bearing walls shall be steel pipe or cast-iron pipe. Sleeves for membrane waterproof floors shall be steel pipe, cast-iron pipe, or plastic pipe. Membrane clamping devices shall be provided on pipe sleeves for waterproof floors. Sleeves in nonbearing walls or ceilings may be steel pipe, cast-iron pipe, galvanized sheet metal with lock-type longitudinal seam, or moisture-resistant fiber or plastic. Plastic sleeves shall not be used in nonbearing fire walls, roofs, or floor/ceilings. Except as otherwise specified, the annular space between pipe and sleeve, or between jacket over insulation and sleeve, shall be sealed as indicated with sealants conforming to ASTM C 920 and with a primer, backstop material and surface preparation as specified in Section 07920 JOINT SEALING. Pipes passing through sleeves in concrete floors over crawl spaces shall be sealed as specified above. The annular space between pipe and sleeve or between jacket over insulation and sleeve shall not be sealed for interior walls which are not designated as fire rated. Sleeves

through below-grade walls in contact with earth shall be recessed 1/2 inch from wall surfaces on both sides. Annular space between pipe and sleeve shall be filled with backing material and sealants in the joint between the pipe and wall as specified above. Sealant selected for the earth side of the wall shall be compatible with dampproofing/waterproofing materials that are to be applied over the joint sealant.

3.1.4.2 Flashing Requirements

Pipes passing through roof or floor waterproofing membrane shall be installed through a 16 ounce copper flashing, each within an integral skirt or flange. Flashing shall be suitably formed, and the skirt or flange shall extend not less than 8 inches from the pipe and shall be set over the roof or floor membrane in a solid coating of bituminous cement. The flashing shall extend up the pipe a minimum of 10 inches. For cleanouts, the flashing shall be turned down into the hub and caulked after placing the ferrule. Pipes passing through pitched roofs shall be flashed, using lead or copper flashing, with an adjustable integral flange of adequate size to extend not less than 8 inches from the pipe in all directions and lapped into the roofing to provide a watertight seal. The annular space between the flashing and the bare pipe or between the flashing and the metal-jacket-covered insulation shall be sealed as indicated. Flashing for dry vents shall be turned down into the pipe to form a waterproof joint. Pipes, up to and including 10 inches in diameter, passing through roof or floor waterproofing membrane may be installed through a cast-iron sleeve with caulking recess, anchor lugs, flashing-clamp device, and pressure ring with brass bolts. Flashing shield shall be fitted into the sleeve clamping device. Pipes passing through wall waterproofing membrane shall be sleeved as described above. A waterproofing clamping flange shall be installed.

3.1.4.3 Waterproofing

Waterproofing at floor-mounted water closets shall be accomplished by forming a flashing guard from soft-tempered sheet copper. The center of the sheet shall be perforated and turned down approximately 1-1/2 inches to fit between the outside diameter of the drainpipe and the inside diameter of the cast-iron or steel pipe sleeve. The turned-down portion of the flashing guard shall be embedded in sealant to a depth of approximately 1-1/2 inches; then the sealant shall be finished off flush to floor level between the flashing guard and drainpipe. The flashing guard of sheet copper shall extend not less than 8 inches from the drainpipe and shall be lapped between the floor membrane in a solid coating of bituminous cement. If cast-iron water closet floor flanges are used, the space between the pipe sleeve and drainpipe shall be sealed with sealant and the flashing guard shall be upturned approximately 1-1/2 inches to fit the outside diameter of the drainpipe and the inside diameter of the water closet floor flange. The upturned portion of the sheet fitted into the floor flange shall be sealed.

3.1.4.4 Optional Counterflashing

Instead of turning the flashing down into a dry vent pipe, or caulking and sealing the annular space between the pipe and flashing or metal-jacket-covered insulation and flashing, counterflashing may be accomplished by utilizing the following:

- a. A standard roof coupling for threaded pipe up to 6 inches in diameter.
- b. A tack-welded or banded-metal rain shield around the pipe.

3.1.4.5 Pipe Penetrations of Slab on Grade Floors

Where pipes, fixture drains, floor drains, cleanouts or similar items penetrate slab on grade floors, except at penetrations of floors with waterproofing membrane as specified in paragraphs Flashing Requirements and Waterproofing, a groove 1/4 to 1/2 inch wide by 1/4 to 3/8 inch deep shall be formed around the pipe, fitting or drain. The groove shall be filled with a sealant as specified in Section 07920 JOINT SEALING.

3.1.5 Supports

3.1.5.1 General

Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. Piping subjected to vertical movement when operating temperatures exceed ambient temperatures shall be supported by variable spring hangers and supports or by constant support hangers. In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run.

3.1.5.2 Pipe Hangers, Inserts, and Supports

Installation of pipe hangers, inserts and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein.

- a. Types 5, 12, and 26 shall not be used.
- b. Type 3 shall not be used on insulated pipe.
- c. Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for type 18 inserts.
- d. Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and shall have both locknuts and retaining devices furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.
- e. Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.
- f. Type 24 may be used only on trapeze hanger systems or on fabricated frames.
- g. Type 39 saddles shall be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher. Type 39 saddles shall be welded to the pipe.
- h. Type 40 shields shall:
 - (1) Be used on insulated pipe less than 4 inches.
 - (2) Be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or less.
 - (3) Have a high density insert for pipe 2 inches and larger and for smaller pipe sizes when the insulation is suspected of being visibly compressed, or distorted at or near the shield/insulation interface. High density inserts shall have a density of 8 pcf or greater.
- I. Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves. Operating temperatures in determining hanger spacing for PVC or CPVC pipe shall be 120 degrees F for PVC and 180 degrees F for CPVC. Horizontal pipe runs shall include allowances for expansion and contraction.
- j. Vertical pipe shall be supported at each floor, except at slab-on-grade, at intervals of not more than 15 feet nor more than 8 feet from end of risers, and at vent terminations. Vertical pipe risers shall include allowances for expansion and contraction.
- k. Type 40 shields used on insulated pipe shall have high density inserts with a density of 8 pcf or greater.

1. Type 35 guides using steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided to allow longitudinal pipe movement. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered. Lateral restraints shall be provided as needed. Where steel slides do not require provisions for lateral restraint the following may be used:

(1) On pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher, a Type 39 saddle, welded to the pipe, may freely rest on a steel plate.

(2) On pipe less than 4 inches a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.

(3) On pipe 4 inches and larger carrying medium less than 60 degrees F a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.

m. Pipe hangers on horizontal insulated pipe shall be the size of the outside diameter of the insulation. The insulation shall be continuous through the hanger on all pipe sizes and applications.

n. Where there are high system temperatures and welding to piping is not desirable, the type 35 guide shall include a pipe cradle, welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 4 inches or by an amount adequate for the insulation, whichever is greater.

3.1.6 Pipe Cleanouts

Pipe cleanouts shall be the same size as the pipe except that cleanout plugs larger than 4 inches will not be required. A cleanout installed in connection with cast-iron soil pipe shall consist of a long-sweep 1/4 bend or one or two 1/8 bends extended to the place shown. An extra-heavy cast-brass or cast-iron ferrule with countersunk cast-brass head screw plug shall be caulked into the hub of the fitting and shall be flush with the floor. Cleanouts in connection with other pipe, where indicated, shall be T-pattern, 90-degree branch drainage fittings with cast-brass screw plugs, except plastic plugs shall be installed in plastic pipe. Plugs shall be the same size as the pipe up to and including 4 inches. Cleanout tee branches with screw plug shall be installed at the foot of soil and waste stacks, at the foot of interior downspouts, on each connection to building storm drain where interior downspouts are indicated, and on each building drain outside the building. Cleanout tee branches may be omitted on stacks in single story buildings with slab-on-grade construction or where less than 18 inches of crawl space is provided under the floor. Cleanouts on pipe concealed in partitions shall be provided with chromium plated bronze, nickel bronze, nickel brass or stainless steel flush type access cover plates. Round access covers shall be provided and secured to plugs with securing screw. Square access covers may be provided with matching frames, anchoring lugs and cover screws. Cleanouts in finished walls shall have access covers and frames installed flush with the finished wall. Cleanouts installed in finished floors subject to foot traffic shall be provided with a chrome-plated cast brass, nickel brass, or nickel bronze cover secured to the plug or cover frame and set flush with the finished floor. Heads of fastening screws shall not project above the cover surface. Where cleanouts are provided with adjustable heads, the heads shall be cast iron.

3.2 OMITTED

3.3 FIXTURES AND FIXTURE TRIMMINGS

Angle stops, straight stops, stops integral with the faucets, or concealed type of lock-shield, and loose-key pattern stops for supplies with threaded, sweat or solvent weld inlets shall be furnished and installed with fixtures. Where connections between copper tubing and faucets are made by rubber compression fittings, a beading tool shall be used to mechanically deform the tubing above the compression fitting. Exposed traps and supply pipes for fixtures and equipment shall be connected to the rough piping systems at the wall, unless otherwise specified under the item. Floor and wall escutcheons shall be as specified. Drain lines and hot water lines of fixtures for handicapped personnel shall be insulated and do not require polished chrome finish. Plumbing fixtures and accessories shall be installed within the space shown.

3.3.1 Fixture Connections

Where space limitations prohibit standard fittings in conjunction with the cast-iron floor flange, special short-radius fittings shall be provided. Connections between earthenware fixtures and flanges on soil pipe shall be made gastight and watertight with a closet-setting compound or neoprene gasket and seal. Use of natural rubber gaskets or putty will not be permitted. Fixtures with outlet flanges shall be set the proper distance from floor or wall to make a first-class joint with the closet-setting compound or gasket and fixture used.

3.3.2 Height of Fixture Rims Above Floor

Installation of fixtures for use by the physically handicapped shall be in accordance with CABO A117.1.

3.3.3 Omitted.

3.3.4 Fixture Supports

Fixture supports for off-the-floor lavatories, urinals, water closets, and other fixtures of similar size, design, and use, shall be of the chair-carrier type. The carrier shall provide the necessary means of mounting the fixture, with a foot or feet to anchor the assembly to the floor slab. Adjustability shall be provided to locate the fixture at the desired height and in proper relation to the wall. Support plates, in lieu of chair carrier, shall be fastened to the wall structure only where it is not possible to anchor a floor-mounted chair carrier to the floor slab.

3.3.4.1 Support for Steel Stud Frame Partitions

Chair carrier shall be used. The anchor feet and tubular uprights shall be of the heavy duty design; and feet (bases) shall be steel and welded to a square or rectangular steel tube upright. Wall plates, in lieu of floor-anchored chair carriers, shall be used only if adjoining steel partition studs are suitably reinforced to support a wall plate bolted to these studs.

3.3.4.2 Support for Wood Stud Construction

Where floor is a concrete slab, a floor-anchored chair carrier shall be used. Where entire construction is wood, wood crosspieces shall be installed. Fixture hanger plates, supports, brackets, or mounting lugs shall be fastened with not less than No. 10 wood screws, 1/4 inch thick minimum steel hanger, or toggle bolts with nut. The wood crosspieces shall extend the full width of the fixture and shall be securely supported.

3.3.5 Backflow Prevention Devices

Plumbing fixtures, equipment, and pipe connections shall not cross connect or interconnect between a potable water supply and any source of nonpotable water. The backflow prevention device shall be installed where indicated and located so that no part of the device will be submerged. Access shall be provided for maintenance and testing. Each device shall be a standard commercial unit.

3.3.6 Access Panels

Access panels shall be provided for concealed valves and controls, or any item requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced, maintained, or replaced.

3.3.7 Sight Drains

Sight drains shall be installed so that the indirect waste will terminate 2 inches above the flood rim of the funnel to provide an acceptable air gap.

3.3.8 Traps

Each trap shall be placed as near the fixture as possible, and no fixture shall be double-trapped. Traps installed on cast-iron soil pipe shall be cast iron. Traps installed on steel pipe or copper tubing shall be recess-drainage pattern, or brass-tube type. Traps installed on plastic pipe may be plastic conforming to ASTM D 3311. Traps for acid-resisting waste shall be of the same material as the pipe.

3.4 ESCUTCHEONS

Escutcheons shall be provided at finished surfaces where bare or insulated piping, exposed to view, passes through floors, walls, or ceilings, except in boiler, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe or pipe covering and shall be satin-finish, corrosion-resisting steel, polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or setscrew.

3.5 Omitted.

3.6 TESTS, FLUSHING, AND STERILIZATION

3.6.1 Plumbing System

The plumbing system shall be tested in accordance with NAPHCC-01.

3.6.2 Defective Work

If inspection or test shows defects, such defective work or material shall be replaced or repaired as necessary and inspection and tests shall be repeated. Repairs to piping shall be made with new materials. Caulking of screwed joints or holes will not be permitted.

3.6.3 System Flushing

After tests are completed, potable water piping shall be flushed. In general, sufficient water shall be used to produce a minimum water velocity of 2.5 feet per second through piping being flushed. Flushing shall be continued until discharge water shows no discoloration. System shall be drained at low points. Strainer screens shall be removed, cleaned, and replaced in line. After flushing and cleaning, systems shall be prepared for service by immediately filling water piping with clean, fresh potable water. Any stoppage, discoloration, or other damage to the finish, furnishings, or parts of the building due to the Contractor's failure to properly clean the piping system shall be repaired by the Contractor. When the work is complete, the hot-water system shall be adjusted for uniform circulation. Flushing devices and automatic control systems shall be adjusted for proper operation.

3.6.4 Operational Test

Upon completion of and prior to acceptance of the installation, the Contractor shall subject the plumbing system to operating tests to demonstrate satisfactory functional and operational efficiency. Such operating tests shall cover a period of not less than 8 hours for each system and shall include the following information in a report with conclusion as to the adequacy of the system:

- a. Time, date, and duration of test.
- b. Water pressures at the most remote and the highest fixtures.
- c. Operation of each fixture and fixture trim.
- d. Operation of each valve, hydrant, and faucet.
- e. Pump suction and discharge pressures.

- f. Temperature of each domestic hot-water supply.
- g. Operation of each floor and roof drain by flooding with water.
- h. Operation of each vacuum breaker and backflow preventer.
- i. Complete operation of each water pressure booster system, including pump start pressure and stop pressure.

3.6.5 Sterilization

After pressure tests have been made, the entire domestic hot- and cold-water distribution system shall be sterilized. System shall be thoroughly flushed with water of sufficient velocity until all entrained dirt and other foreign material have been removed, before introducing chlorinating material. The chlorinating material shall be hypochlorites or liquid chlorine. Water chlorination procedure shall be in accordance with AWWA M20. The chlorinating material shall be fed into the water piping system at a constant rate at a concentration of at least 50 parts per million (ppm). A properly adjusted hypochlorite solution injected into the main with a hypochlorinator, or liquid chlorine injected into the main through a solution-feed chlorinator and booster pump, shall be used. The chlorine residual shall be checked at intervals to ensure that the proper level is maintained. Chlorine application shall continue until the entire main is filled. The water shall remain in the system for a minimum of 24 hours. Each valve in the system being sterilized shall be opened and closed several times during the contact period to ensure its proper disinfection. Following the 24-hour period, no less than 25 ppm chlorine residual shall remain in the system. Water tanks shall be disinfected by the addition of chlorine directly to the filling water. Following a 6 hour period, no less than 50 ppm chlorine residual shall remain in the tank. The system including the tanks shall then be flushed with clean water until the residual chlorine is reduced to less than one part per million. During the flushing period each valve and faucet shall be opened and closed several times. From several points in the system the Contracting Officer will take samples of water in properly sterilized containers for bacterial examination. The samples of water shall be tested for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA-01. The testing method used shall be either the multiple-tube fermentation technique or the membrane-filter technique. The sterilizing shall be repeated until tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained.

3.7 PLUMBING FIXTURE SCHEDULE

P-1 WATER CLOSET:

Siphon-jet, elongated bowl, top supply spud, ASME A112.19.2M, floor mounted. Floor flange shall be copper alloy, cast iron, or plastic. Top rim of bowl shall be 18 inches above the floor.

Gasket shall be wax type.

Seat - CID A-A-238, Type A, white plastic, elongated, open front.

Flushometer Valve - ASSE 1037, large diaphragm type with non-hold-open feature, backcheck angle control stop, and vacuum breaker. Minimum upper chamber inside diameter of not less than 2-5/8 inches at the point where the diaphragm is sealed between the upper and lower chambers. The maximum water use shall be 1.6 gallons per flush.

P-2 WATER CLOSET HANDICAPPED:

Top rim of bowl shall be 18 inches above the floor; other features are the same as P-1.

P-3 LAVATORY:

Manufacturer's standard sink depth, FS WW-P-541/4, solid surface (uniform density, thickness and color throughout), compression molded, 19" round, drop-in, self rimming. Faucet - Faucets shall be center set single control, mixing type. Faucets shall have metal replaceable cartridge control unit or metal cartridge units with diaphragm which can be replaced without special tools. Valves and handles shall be copper alloy. Connection between valve and spout for center-set faucet shall be of rigid metal tubing. Flow shall be limited to 2.5 gpm at a flowing pressure of 80 psi.

Handles - Lever type. Cast, formed, or drop forged copper alloy.

Drain - Pop-up drain shall include stopper, lift rods, jam nut, washer, and tail piece. Drain and hot water piping shall be insulated or configured to prevent contact. See paragraph FIXTURES for optional plastic accessories.

Trap - Cast iron.

P-4 KITCHEN SINK:

FS WW-P-541/5, ledge back with holes for faucet and spout, 18 gauge, Single compartment (21by 25 inches X 8 inches deep), drop-in, 301 stainless steel.

Faucet and Spout - Cast or wrought copper alloy. Aerator shall have internal threads. Flow shall be limited to 0.25 gpm per cycle at a flowing water pressure of 80 psi if a metering device or fitting is used that limits the period of water discharge such as a foot switch or fixture occupancy sensor. If a metering device is not used, the flow shall be limited to 2.5 gpm at a flowing water pressure of 80 psi.

Handle - Cast copper alloy, wrought copper alloy, or stainless steel. Single lever type.

Drain Assembly - Plug, cup strainer, crossbars, jam nuts, washers, couplings, stopper, etc. shall be copper alloy or stainless steel.

P-5 WATER COOLER DRINKING FOUNTAINS:

Water cooler drinking fountains shall: be self contained, conform to ARI 1010, use one of the halogenated fluorocarbons as a refrigerant, have a capacity to deliver 8 gph of water at 50 degrees F with an inlet water temperature of 80 degrees F while residing in a room environment of 90 degrees F, and have self-closing valves. Self-closing valves shall have automatic stream regulators, have a flow control capability, have a push button actuation or have a cross-shaped index metal turn handle without a hood. Exposed surfaces of stainless steel shall have No. 4 general polish finish. Spouts shall provide a flow of water at least 4 inches high so as to allow the insertion of a cup or glass under the flow of water.

Handicapped - The dimensions shall be 19 inches wide, 18 inches long and 23 inches high. A clear knee space shall exist between the bottom of the bowl and the floor or ground of at least 27 inches and between the front edge of the bowl and the body of the unit of at least 8 inches. An 8-inch wide clear space shall exist on both sides of the unit. The spout height shall be no more than 36 inches above the floor or ground to the outlet. The spout shall be at the front of the unit and direct the water flow in a trajectory that is parallel or nearly parallel to the front of the unit. The unit shall have front and side push bars.

P-6 SHOWER

Units shall be vacuum-formed from one-piece sanitary grade methyl-acrylate (acrylic) with a finished Barcol hardness of 40. Unit construction is of molded, reinforced fiberglass with a minimum of 15% fiberglass content. Units have a cellular inner core. Units shall have a reinforced fiberglass outer protective coating.

Valves (pressure balancing) - Cast or wrought copper alloy or stainless steel. Built-in valve with single lever handle. Example: Moen 8320, pressure balancing valve. The flow shall be limited to a minimum 2.5 gpm.

Shower Head – Bent arm and wall flange with “deluxe” head. ½” IPS.

Handle - Cast copper alloy, wrought copper alloy, or stainless steel. Single lever type.

Drain Assembly - Grid strainer, chrome.

P-7 MOP RECEPTOR

Unit shall be one-piece molded construction using fused natural crushed stone with polyester resin. Shall have integrally molded drain assembly with drain seal and stainless steel strainer for connection to 3" pipe. Shall be 24" deep x 36" wide x 10" high with 1" wide shoulder and have integrally molded self-draining shelf.

Service Faucet - Chrome plated brass service sink faucet, 1/2" pipe eccentric inlets on 8" centers. Vacuum breaker integral stops, chrome plated (H & C) handles, 3/4" hose spout with pail hook, top reinforcing bar and mounting bracket. Shall meet ANSI Specifications A112.1.1, Section 2.9 and A112.18.1M.

Trap - Cast iron.

3.8 PERFORMANCE OF WATER HEATING EQUIPMENT

Standard rating condition terms are as follows:

EF = Energy factor, overall efficiency.

ET = Thermal efficiency with 70 degrees F delta T.

EC = Combustion efficiency, 100 percent - flue loss when smoke = 0 (trace is permitted).

SL = Standby loss in W/sq. ft. based on 80 degrees F delta T, or in percent per hour based on nominal 90 degrees F delta T.

HL = Heat loss of tank surface area.

V = Storage volume in gallons

3.8.1 Storage Water Heaters

3.8.1.1 Electric

a. Storage capacity of 120 gallons or less, and input rating of 12 kW or less: minimum energy factor (EF) shall be 0.95-0.00132V per 10 CFR 430.

TABLE I
PIPE AND FITTING MATERIALS FOR
DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

SERVICE							
Item No.	Pipe and Fitting Materials	A	B	C	D	E	F
1	Cast iron soil pipe and fittings, hub and spigot, ASTM A 74 with compression gaskets	X	X	X	X	X	
2	Cast iron pipe and fittings hubless, CISPI 301 and ASTM	X	X	X	X		

A 888						
3	C Cast iron drainage fittings, threaded, ASME B16.12 for use with Item 10	X			X	X
4	Cast iron screwed fittings (threaded) ASME B16.4 for use with Item 10				X	X
5	Bronze sand casting grooved joint pressure fittings for non-ferrous pipe ASTM B 584, for use with Item 5	X	X		X	X
6	Wrought copper grooved joint pressure pressure fittings for non-ferrous pipe ASTM B 75 C12200, ASTM B 152 C11000, ASME B16.22 ASME B16.22 for use with Item 5	X	X			
7	Malleable-iron threaded fittings, galvanized ASME B16.3 for use with Item 10				X	X
8	Seamless red brass pipe, ASTM B 43				X	X
9	Bronzed flanged fittings, ASME B16.24 for use with Items 11 and 14				X	X
10	Cast copper alloy solder joint pressure fittings, ASME B16.18 for use with Item 14				X	X
11	Seamless copper pipe, ASTM B 42	X				X
12	Cast bronze threaded fittings, ASME B16.15				X	X
13	Copper drainage tube, (DWV), ASTM B 306	X*	X	X*	X	X
14	Wrought copper and wrought alloy solder-joint drainage fittings. ASME B16.29	X	X	X	X	X
15	Cast copper alloy solder joint drainage fittings, DWV, ASME B16.23	X	X	X	X	X

SERVICE:

A - Underground Building Soil, Waste and Storm Drain

B - Aboveground Soil, Waste, Drain In Buildings

C - Underground Vent

D - Aboveground Vent

E - Interior Rainwater Conductors Aboveground

F - Corrosive Waste And Vent Above And Belowground

* - Hard Temper

TABLE II
PIPE AND FITTING MATERIALS FOR
PRESSURE PIPING SYSTEMS

SERVICE

Item No.	Pipe and Fitting Materials	A	B	C	D
1	Malleable-iron threaded fittings, a. Galvanized, ASME B16.3 for use with Item 4a	X	X	X	X
	b. Same as "a" but not galvanized Item 4b		X		
2	Grooved pipe couplings, ferrous pipe ASTM A 536 and ASTM A 47, non-ferrous pipe, ASTM A 536 and ASTM A 47	X	X	X	
3	Ductile iron grooved joint fittings for ferrous pipe ASTM A 536 and ASTM A 47 for use with Item 2	X	X	X	
4	Steel pipe: a. Seamless, galvanized, ASTM A 53, Type S, Grade B	X	X	X	X
	b. Seamless, black, ASTM A 53, Type S, Grade B			X	
5	Seamless red brass pipe, ASTM B 43	X	X		X
6	Bronze flanged fittings, ASME B16.24 for use with Items 4 and 6	X	X		X
7	Seamless copper pipe, ASTM B 42	X	X		X
8	Seamless copper water tube, ASTM B 88	X**	X**	X**	X****
9	Seamless and welded copper distribution tube (Type D) ASTM B 641	X**	X**	X**	X*****
10	Cast bronze threaded fittings, ASME B16.15 for use with Items 7 and 8	X	X		X
11	Wrought copper and bronze solder-joint pressure fittings, ASME B16.22 for use with Items 7 and 8	X	X	X	X
12	Cast copper alloy solder-joint pressure fittings, ASME B16.18 for use with Items 7 and 8	X	X	X	X
13	Bronze and sand castings grooved joint pressure fittings for non- ferrous pipe ASTM B 584, for use with Item 2	X	X	X	
14	Steel pipeline flanges, MSS SP-44	X	X		
15	Unions: brass or bronze, FS WW-U-516	X	X		

16	Carbon steel pipe unions, socket-welding and threaded, MSS SP-83	X	X	X
17	Malleable-iron threaded pipe unions ASME B16.39	X	X	
18	Nipples, pipe threaded ASTM A 733	X	X	X

A - Cold Water Aboveground

B - Hot Water 80 degrees F Maximum Aboveground

C - Compressed Air Lubricated

D - Cold Water Service Belowground

Indicated types are minimum wall thicknesses.

** - Type L - Hard

*** - Type K - Hard temper with brazed joints only or type K-soft temper without joints in or under floors

**** - In or under slab floors only brazed joints

(END OF SECTION)

SECTION 15775**FIELD-ERECTED HEAT PUMP SYSTEM****PART 1 GENERAL****1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 495	(1993) Refrigerant Liquid Receivers
ARI 710	(1986) Liquid-Line Driers
ARI 720	(1988) Refrigerant Access Valves and Hose Connectors
ARI 750	(1987) Thermostatic Refrigerant Expansion Valves
ARI 760	(1987) Solenoid Valves for Use with Volatile Refrigerants

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1993a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 307	(1994) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 334	(1991) Seamless and Welded Carbon and Alloy-Steel Tubes for Low-Temperature Service
ASTM B 280	(1993a) Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
ASTM D 520	(1984; R 1989) Zinc Dust Pigment
ASTM 3308	(1991a) PTFE Resin Skived Tape
ASTM F 104	(1993) Nonmetallic Gasket Materials

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 15	(1994) Safety Code for Mechanical Refrigeration
-----------	---

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)
ASME B31.1	(1992; B31.1a; B31.1b; B31.1c) Power Piping
ASME B31.5	(1992; B31.5a) Refrigeration Piping

ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element
ASME BPV VIII Div 1	(1992; Addenda Dec 1992, Dec 1993, Dec 1994) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage
ASME BPV IX	(1992; Addenda Dec 1992, Dec 1993, Dec 1994) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(1994) Structural Welding Code - Steel
----------	--

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABEMA)

ABEMA 9	(1990) Load Ratings and Fatigue Life for Ball Bearings
ABEMA 11	(1990) Load Ratings and Fatigue Life for Roller Bearings

FEDERAL SPECIFICATIONS (FS)

FS BB-F-1421	(Rev B) Fluorocarbon Refrigerants
FS QQ-B-654	(Rev A; Am 1; Notice 1) Brazing Alloys, Silver

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1991) Pipe Hangers and Supports - Selection and Application

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1993) National Electrical Code
---------	---------------------------------

UNDERWRITERS LABORATORIES (UL)

UL 1995	(1990) Heating and Cooling Equipment
---------	--------------------------------------

1.2 SYSTEM DESCRIPTION

The heat pump system shall be provided and installed complete and functional, with necessary Heat Pump Components, Accessories, Refrigerant Piping, and Supplemental Components/Services. The system shall be either modular pre-engineered components assembled into a field assembled heat pump or a custom made, field assembled, heat pump package from a single manufacturer. The heat pump system shall be capable of both heating and cooling as indicated on the contract drawings.

1.3 SUBMITTALS

The following shall be submitted for Government approval:

1.3.1 Data

Heat Pump System

Manufacturer's catalog data with detail drawings for the following items:

- a. Applied Heat Pump System
- b. Heat Pump Components
- c. Accessories
- d. Refrigerant Piping

The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of parts recommended by the manufacturer to be replaced after 1 and 3 years of service. Data shall be adequate to demonstrate compliance with contract requirements.

1.3.2 Drawings

Heat Pump System

Detail drawings comprised of a list of equipment and material including manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, and installation instructions. Detail drawings shall also contain complete wiring and schematic diagrams and any other details required to demonstrate the system has been designed to properly function as a unit. Drawings shall show proposed equipment layout, anchorage of equipment and appurtenances, and equipment in relationship to other parts of the work including clearances for maintenance and operations.

1.3.3 Statements

Verification of Dimensions

A letter, at least 2 weeks prior to beginning construction, including the date the site was visited, conformation of existing conditions, and any discrepancies found.

1.3.4 Certificates

Materials and Equipment

Where equipment or materials are specified to comply with requirements of ARI, ASHRAE, ASME, or UL, proof of such compliance. The label or listing of the specified agency will be acceptable evidence. In lieu of the label or listing, a written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency. When performance requirements of this project's drawings and specifications vary from standard ARI rating conditions, computer printouts, catalog, or other application data certified by ARI or a nationally recognized laboratory as described above shall be included. If ARI does not have a current certification program that encompasses such application data, the manufacturer's application data may be self certified. The self certification shall comply with project performance requirements in accordance with the specified tests standards.

1.3.5 Operation and Maintenance Manuals

Operation Manual

Six copies, at least 2 weeks prior to the demonstrations, of an operation manual in bound 8-1/2 x 11 inch booklets listing step-by-step procedures required for system startup, operation, and shutdown. The booklets shall include the manufacturer's name, model number, and parts list. The manuals shall include the manufacturer's name, model number, service manual, and a brief description of all equipment and their basic operating features.

Maintenance Manual

Six copies, at least 2 weeks prior to the demonstrations, of maintenance manual in bound 8-1/2 x 11 inch booklets listing routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide. The

manuals shall include piping and equipment layouts and simplified wiring and control diagrams of the system as installed.

1.4 SAFETY REQUIREMENTS

Exposed moving parts, parts that produce high operating temperature, parts which may be electrically energized, and parts that may be a hazard to operating personnel shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Safety devices shall be installed so that proper operation of equipment is not impaired.

1.5 DELIVERY, STORAGE, AND HANDLING

Material and equipment placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt, dust, and other contaminants.

1.6 PROJECT/SITE CONDITIONS

1.6.1 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field and shall advise the Contracting Officer of any discrepancy before performing any work.

1.6.2 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. The Contractor shall investigate the plumbing, fire protection, electrical, structural, and finish conditions that would affect the work to be performed and shall arrange such work accordingly, furnishing required ductwork offsets, fittings, and accessories to meet such conditions.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Components and equipment shall be products of a manufacturer regularly engaged in the manufacturing of custom-built components and modular sections. The manufacturer's custom-made products shall have been in satisfactory commercial or industrial use for at least 2 years prior to bid opening. Where manufacturer's custom-made products do not have a 2-year field service record, a certified record of satisfactory field operation, for not less than 6000 hours exclusive of manufacturer's factory tests, can be shown. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size as those indicated. Equipment components shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

2.2 NAMEPLATES

Each major component of equipment shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the equipment.

2.3 ELECTRICAL WORK

Electrical equipment, motors, and wiring shall be in accordance with Section 16415 ELECTRICAL WORK, INTERIOR. Electrical motor driven equipment specified shall be provided complete with motors, motor starters, and controls. Electrical characteristics and enclosure type shall be as shown, and unless otherwise indicated, all motors of 1 horsepower and above with open, dripproof, or totally enclosed fan cooled enclosures, shall be high efficiency type. Field wiring shall be in accordance with manufacturer's instructions. Motor starters shall be provided complete with thermal overload protection and other appurtenances necessary for the motor control

indicated. Each motor shall be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown, shall be provided.

2.4 MATERIALS

2.4.1 Steel Pipe

Steel pipe shall conform to ASTM A 53, Schedule 40, Type E or S, Grades A or B. Type F pipe shall not be used.

2.4.2 Gaskets

Gaskets shall conform to ASTM F 104 - classification for compressed sheet with nitrile binder and acrylic fibers for maximum 700 degrees F service.

2.4.3 Bolts and Nuts

Bolts and nuts, except as required for piping applications, shall be in accordance with ASTM A 307. The bolt head shall be marked to identify the manufacturer and the standard with which the bolt complies in accordance with ASTM A 307.

2.4.4 Escutcheons

Escutcheons shall be chromium-plated iron or chromium-plated brass, either one piece or split pattern, held in place by internal spring tension or set screws.

2.4.5 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69.

2.4.6 Gauges

Gauges shall conform to ASME B40.1, Class 1, 2, or 3, Style X, Type I or III as required, 4-1/2 inches in diameter with phenolic or metal case.

2.5 HEAT PUMP COMPONENTS

2.5.1 Refrigerant

Refrigerants shall be one of the fluorocarbon gases, in accordance with FS BB-F-1421, and shall have an Ozone Depletion Potential of less than or equal to 0.05.

2.5.2 Compressor

2.5.2.1 General

Rotating parts shall be statically and dynamically balanced. When multiple compressors are used, the compressors shall operate in sequence. Suction and discharge valves shall be flange or sweat connected, wrench operated, rising stem, with cap. Suction side of the compressor shall be furnished with strainer. Each compressor shall be provided with cylinder unloading at startup, vibration isolators, hot gas bypass, thermal overloads, high-and-low pressure safety cutoffs, low oil pressure cutout, internal motor-winding temperature sensing protection device, internal pressure relief valve, a complete oil charge, and protection against short cycling.

2.5.2.2 Reciprocating Compressor

Compressor shall be capable of operating at partial-load conditions without increased vibration over the normal vibration at full load operation and shall be capable of continuous operation down to the lowest step of unloading as specified. Compressors with a capacity of 10 horsepower and above shall have an oil lubrication system of the reversible, forced-feed type with oil strainer. Shaft seal in open-type units shall be mechanical type. Piston speed for open-type compressors shall not exceed the manufacturer's recommendation or 1200 fpm, whichever is less.

2.5.2.3 Scroll Compressor

Compressor shall be of the hermetically sealed design. Lubrication system shall be centrifugal pump type equipped with an oil level bull's eye sight glass and an oil charging valve. Crankcase oil heater shall be provided if standard or if available as an option. If provided, the crankcase oil heater shall be controlled as recommended by the manufacturer.

2.5.2.4 OMITTED

2.5.2.5 OMITTED

2.5.2.6 Compressor Driver Connections

Each compressor shall be driven by a V-belt drive or direct connected through a flexible coupling, except that flexible coupling is not required on hermetic units. V-belt drives shall be designed for not less than 150 percent of the driving motor capacity. Flexible couplings shall be of the type that does not require lubrication.

2.5.2.7 Oil System

Compressor oil shall be of a type recommended by the manufacturer of the equipment. Oil shall be provided at the proper pressure to all parts requiring lubrication. Provide crankcase oil heater which is removable, serviceable, and controlled as recommended by the manufacturer. Oil cooler shall be provided and sized in accordance with the manufacturer's recommendations.

2.5.2.8 Capacity Controls

Compressor shall be capable of modulation from 100 percent capacity to 50 percent capacity. Manual reset shall be provided on the cutouts. Suction, discharge, and oil pressure gauges shall be provided. Pressure cutouts and gauges shall be factory mounted on a gauge board. Alarm circuit terminals shall be provided in the control panel to actuate a 4 inch diameter alarm bell in the event of machine cutout on any protective device except when the low pressure control is used as an operating control. Alarm bell shall be located where indicated. Transformer for the bell circuit requiring low voltage shall be provided.

2.5.3 Coils

2.5.3.1 Operation

During the heating cycle of the heat pump system the indoor coil shall operate as the condensing unit while the outdoor coil shall operate as the evaporating unit. The indoor and outdoor coils shall be capable of swapping duties as condenser and evaporator at the beginning of the cooling cycle. The indoor and outdoor coils shall be located as indicated on the contract drawings.

2.5.3.2 Type

The indoor coil shall be an air source coil. The outdoor coil shall be an air source coil.

2.5.3.3 Construction

a. Air Source Coil. Air source coils or direct expansion coils shall be provided as specified in Section 15895 AIR SUPPLY AND DISTRIBUTION SYSTEM FOR AIR-CONDITIONING SYSTEM.

2.5.3.4 Condenser Fans

Fans shall be centrifugal or propeller type as best suited for the application. Fans shall be statically and dynamically balanced. Fans shall be direct or V-belt driven. Belt drives shall be completely enclosed within the unit casing or equipped with a guard. When belt drive is provided, an adjustable sheave to furnish not less than 20 percent fan-speed adjustment shall be provided for centrifugal fans. Sheaves shall be selected to provide the required capacity at the approximate midpoint of the adjustment. Fan capacity shall be indicated on the contract drawings.

2.5.4 Supplemental Heat

2.5.4.1 Electric Resistance Heater

Electric resistance heater shall be the unit-mounted type consisting of nickel chromium resistor mounted on refractory material and a steel or aluminum frame. Electric heaters shall meet the requirements of UL 1995 and NFPA 70, and shall be provided with a built-in or surface-mounted high-limit thermostat interlocked electrically so that it cannot be energized unless the fan is running.

2.5.5 Liquid Receiver

Liquid receivers shall be designed, fitted, and rated in accordance with the recommendations of ARI 495, except as modified herein. Inner surfaces shall be thoroughly cleaned by sandblasting or other approved means. Each receiver shall have a storage capacity not less than 20 percent in excess of that required for the fully charged system. Each receiver shall be equipped with inlet and outlet drop pipe, drain plug, purging valve, relief valves of capacity and setting required by ASHRAE 15 and two bull's-eye liquid-level sight glasses. Sight glasses shall be in the same vertical plane, 90 degrees apart, perpendicular to the axis of the receiver, and not over 3 inches horizontally from the drop pipe measured along the axis of the receiver. In lieu of bull's-eye sight glass, external gauge glass with metal glass guard and automatic closing stop valves may be provided.

2.5.6 Reversing Valves

Reversing valve shall be pilot operated by a spring loaded solenoid and designed for fail safe to the heating mode.

2.5.7 Refrigeration Circuits

Each refrigerant circuit shall be complete with interconnecting refrigerant piping, refrigerant charge, oil charge, suction and discharge pressure gauges, expansion valve, filter dryer, sight glass, refrigerant charging valves and connections, pumpdown valves, and all other components indicated. Units shall have the number of circuits indicated. Refrigerant-containing components shall comply with ASHRAE 15 and shall be factory tested, cleaned, dehydrated, charged, and sealed. Each coil connection shall be fitted with a manual isolation valve and one access valve per coil on the coil side.

2.5.8 Tools

One complete set of special tools as recommended by the manufacturer for field maintenance of the system shall be provided. Tools shall be mounted on a tool board in the equipment room or contained in a tool box as directed by the Contracting Officer.

2.5.9 Mounting Base

Unit shall be mounted on all-welded structural steel or cast iron base complete with vibration isolators with published load rating. The entire unit shall be isolated from the building structure.

2.5.10 Control Panel

Panel components shall be coordinated with the requirements of paragraph Automatic Heat Pump Controls. The control panel shall include all relays or appurtenances required for safe controlled operation.

2.5.11 System Efficiency

The overall minimum energy efficiency for the entire heat pump system shall be as indicated in schedule.

2.5.12 Automatic Heat Pump Controls

Automatic heat pump controls shall be as specified in Section 15950 HEATING, VENTILATING AND AIR CONDITIONING HVAC CONTROL SYSTEMS. The heat pump system shall be provided with the necessary control devices required for normal heating/cooling operation. The automatic heat pump controls shall also include each of the following:

- a. Automatic reversing from cooling mode to heating mode and vice versa.
- b. A safe system operating mode when controls fail.
- c. Indications for system failure.
- d. Protective mechanisms and controls that are required for the safe operation of all system equipment.
- e. Defrost system shall be capable of reversing the coils function (evaporator to condenser) for a controlled amount of time sufficient to provide system defrost.

2.5.12.1 OMITTED

2.5.12.2 OMITTED

2.5.13 Head Pressure Control

2.5.13.1 Air Source Coil(s)

Head pressure control for the air source coil shall be provided in accordance with one of the following requirements:

a. Air Volume Control: On a decrease in refrigerant discharge pressure, volume control dampers shall modulate to control the airflow over the coil. Solid-state variable-speed fan motor controller may be provided in lieu of volume dampers to control the air flow over the coil. Coil with multiple fans may be provided with fan cycling control in lieu of volume control dampers, to cycle fans in response to the saturated refrigerant condensing temperature. Control shall be set for a minimum of 95 degrees F saturated refrigerant condensing temperature.

b. Coil Flooding: On a decrease in refrigerant discharge pressure, a head pressure sensitive valve shall throttle refrigerant outflow to increase the amount of liquid in the coil. A differential pressure hot-gas bypass valve shall be provided to maintain receiver pressure which opens as the receiver pressure falls. Control shall be set for minimum of 95 degrees F saturated refrigerant condensing temperature.

2.5.13.2 OMITTED

2.5.13.3 Low Temperature Control Package

The coil shall be provided with a low ambient temperature control package which permits the compressor to start and run and the head pressure maintained at ambient temperatures down to minus 20 degrees F.

2.6 ACCESSORIES

2.6.1 OMITTED

2.6.2 Oxygen Sensor

The Contractor shall equip the mechanical room with an oxygen sensor if the heat pump system provided utilizes R-22 or R-134a. The oxygen sensor shall initiate an alarm if oxygen levels in the mechanical room, where the heat pump components are located, drop below 19.5 volume percent. The sensor shall be specifically designed to measure the percent oxygen level within an area. The sensor shall have an adjustable sensitivity such that it will alarm when the oxygen level is 21 volume percent and below. The sensor shall be located in an area of the mechanical room where refrigerant from the heat pump system is likely to concentrate.

2.6.3 OMITTED

2.7 REFRIGERANT PIPING

Refrigerant piping, valves, fittings, and accessories shall conform to the requirements of ASHRAE 15 and ASME B31.5, except as specified.

2.7.1 Steel Pipe

Steel pipe for refrigerant service shall conform to ASTM A 53, Schedule 40, Type E or S, grades A or B. Type F pipe shall not be used.

2.7.2 Joints and Fittings, Steel Pipe

Joints and fittings shall be steel butt-welding, socket-welding, or malleable iron threaded type. Pipe shall be welded except that joints on lines 2 inches and smaller may be threaded. Threads shall be tapered type conforming to ASME B1.20.1. The malleable iron threaded type fitting shall be of a weight corresponding to adjacent pipe. Flanges and flange faces of fittings shall be tongue-and-groove type with gaskets suitable for the refrigerant used; size 1 inch and smaller shall be oval, two-bolt type; size above 1 inch, up to and including 4 inches, shall be square four-bolt type; and sizes over 4 inches shall be round.

2.7.3 Steel Tubing

Steel tubing for refrigeration service shall be in accordance with ASTM A 334, Grade 1. Tubing with a nominal diameter of 3/8 inch or 1/2 inch shall have a wall thickness of 0.049 inches. Tubing with a nominal diameter of 3/4 through 2 inches shall have a wall thickness of 0.065 inches. Tubing with a nominal diameter of 2-1/2 through 4 inches shall have a wall thickness of 0.095 inches. Steel tubing shall be cold-rolled, electric-forged, welded-steel. One end of the tubing shall be provided with a socket. Steel tubing shall be cleaned, dehydrated, and capped.

2.7.4 Joints and Fittings, Steel Tubing

Joints and fittings shall be socket type provided by the steel tubing manufacturer.

2.7.5 Copper Tubing

Copper tubing shall conform to ASTM B 280 annealed or hard drawn as required. Copper tubing shall be soft annealed where bending is required and hard drawn where no bending is required. Soft annealed copper tubing shall not be used in sizes larger than 1-3/8 inches. Joints shall be brazed except that joints on lines 7/8 inch and smaller may be flared.

2.7.6 Joints and Fittings, Copper Tubing

Copper tube joints and fittings shall be flare joint type with short-shank flare, or solder-joint pressure type. Joints and fittings for brazed joint shall be wrought-copper or forged-brass sweat fittings. Cast sweat-type joints and fittings shall not be allowed for brazed joints.

2.7.7 Valves

Valves shall be pressure and temperature rated for contained refrigerant service and shall comply with ASME B31.5. Metals of construction shall be ferrous or copper based. Atmosphere exposed valve stems shall be stainless steel or corrosion resistant metal plated carbon steel. Valve body connection shall be brazed or welded socket, flanged or combination thereof. Threaded connections shall not be used, except in pilot pressure or gauge lines where maintenance disassembly is required and welded flanges cannot be used. Valves shall be suitable for or fitted with extended copper ends for brazing in-place without disassembly. Ferrous body valves shall be fitted with factory fabricated and brazed copper transitions. To minimize system pressure drops, where applicable, globe valves shall be angle body type, and straight line valves shall be full port ball type, control valve inlets shall be fitted with integral or adapted strainer or filter where recommended or required by manufacturer. Valves shall be cleaned and sealed moisture-tight.

2.7.7.1 Refrigerant-Stop Valves

Valves in sizes through 5/8 inch, shall be handwheel operated, straight or angle, packless diaphragm globe type with back-seating stem, brazed ends, except where SAE flare or retained seal cap connections are required. In sizes over 5/8 inch, valves shall be globe or angle type, wrench operated with ground-finish stems, or ball valves, packed especially for refrigerant service, back seated, and provided with seal caps. Refrigerant isolation and shutoff valves shall have retained or captive spindles and facilities for tightening or replacement of the gland packing under line pressure as applicable. Stop valves shall have back-seating plated steel stem, bolted bonnet in sizes 1-1/8 inches OD and larger, integral or flanged transition brazed socket. Valves in sizes through 2-1/2 inches shall be end-entry body assembly, ball, seats and seals of tetrafluoroethylene, chrome plated or stainless steel stem, and seal cap. In sizes 4 inch IPS and larger, and in smaller size where carbon steel piping is used, valve bodies shall be tongue and groove flanged and complete with mating flange, gaskets and bolting for socket or butt-weld connection. Purge, charge and receiver valves shall be of manufacturer's standard configuration.

2.7.7.2 Check Valves

Valve shall be designed for service application, spring-loaded type where required, with resilient seat and with flanged body in sizes 1/2 inch and larger.

2.7.7.3 Liquid Solenoid Valves

Valves shall comply with ARI 760 and be suitable for continuous duty with applied voltages 15 percent under and 5 percent over nominal rates voltage at maximum and minimum encountered pressure and temperature service conditions. Valves shall be direct-acting or pilot-operating type, packless, except that packed stem, seal capped, manual lifting provisions shall be furnished. Solenoid coils shall be moisture-proof, UL approved, totally encapsulated or encapsulated and metal jacketed as required.

Valves shall have safe working pressure of 400 psi and a maximum operating pressure differential of at least 200 psi at 85 percent rated voltage. Valves shall have an operating pressure differential suitable for the refrigerant used.

2.7.7.4 Expansion Valves

Expansion valves shall conform to requirements of ARI 750. Valve shall be of the diaphragm and spring type with internal or external equalizers, and bulb and capillary tubing. Valve shall be provided with an external superheat adjustment along with a seal cap. Internal equalizers may be utilized where floating refrigerant pressure drop between outlet of the valve and inlet to the evaporator coil is negligible and pressure drop across the evaporator is less than the pressure difference corresponding to 2 degrees F of saturated suction temperature at evaporator conditions. Bulb charge shall be determined by the manufacturer for the application and such that liquid will remain in the bulb at all operating conditions. Gas limited liquid charged valves and other valve devices for limiting evaporator pressure shall not be used without a distributor or discharge tube or effective means to prevent loss of control when bulb becomes warmer than valve body. Pilot-operated valves shall have a characterized plug to provide required modulating control. A de-energized solenoid valve may be used in the pilot line to close the main valve in lieu of a solenoid valve in the main liquid line. An isolatable pressure gauge shall be provided in the pilot

line, at the main valve. Automatic pressure reducing or constant pressure regulating expansion valves may be used only where indicated or for constant evaporator loads.

2.7.7.5 Safety Relief Valve

Valve shall be the two-way type. Single type valves shall be used only where indicated. Valve shall bear the ASME code symbol. Valve capacity shall be certified by the National Board of Boiler and Pressure Vessel Inspectors. Valve shall be of an automatically reseating design after activation.

2.7.7.6 Evaporator Pressure regulators, Direct-Acting

Valve shall include a diaphragm/spring power assembly, external pressure adjustment with seal cap, and pressure gauge port. Valve shall maintain a constant inlet pressure by balancing inlet pressure on diaphragm against an adjustable spring load. Pressure drop at system design load shall not exceed the pressure difference corresponding to a 2 degrees F change in saturated refrigerant temperature at evaporator operating suction temperature. Spring shall be selected for indicated maximum allowable suction pressure range.

2.7.7.7 Refrigerant Access Valves

Refrigerant access valves and hose connections shall be in accordance with ARI 720.

2.7.8 Accessories

2.7.8.1 Filter Driers

Driers shall conform to ARI 710. Sizes 5/8 inch and larger shall be the full flow, replaceable core type. Sizes 1/2 inch and smaller shall be the sealed type. Cores shall be of suitable desiccant that will not plug, cake, dust, channel, or break down, and shall remove water, acid, and foreign material from the refrigerant. Filter driers shall be constructed so that none of the desiccant will pass into the refrigerant lines. Minimum bursting pressure shall be 1500 psi.

2.7.8.2 Sight Glass and Liquid Level Indicator

a. Assembly and Components: Assembly shall be pressure- and temperature-rated and constructed of materials suitable for the service. Glass shall be borosilicate type. Ferrous components subject to condensation shall be electro-galvanized.

b. Gauge Glass: Gauge glass shall include top and bottom isolation valves fitted with automatic checks, and packing followers; red-line or green-line gauge glass; elastomer or polymer packing to suit the service; and gauge glass guard.

c. Bull's-Eye and Inline Sight Glass Reflex Lens: Bull's-eye and inline sight glass reflex lens shall be provided for dead-end liquid service. For pipe line mounting, two plain lenses in one body suitable for backlighting viewing shall be provided.

d. Moisture Indicator: Indicator shall be a self-reversible action, moisture reactive, color changing media. Indicator shall be furnished with full-color-printing tag containing color, moisture and temperature criteria. Unless otherwise indicated, the moisture indicator shall be an integral part of each corresponding sight glass.

2.7.8.3 Vibration Dampeners

Dampeners shall be of the all-metallic bellows and woven-wire type.

2.7.8.4 Flexible Pipe Connectors

Connector shall be pressure and temperature rated for the service in accordance with ASHRAE 15 and ASME B31.5. Connector shall be a composite of interior corrugated phosphor bronze or Type 300 series Stainless Steel, as required for fluid service, with exterior reinforcement of bronze, stainless steel or monel wire braid. Assembly shall be constructed with a safety factor of not less than 4 at 300 degrees F. Unless otherwise indicated, the length of a flexible connector shall be as recommended by the manufacturer for the service intended.

2.7.8.5 Strainers

Strainers used in refrigerant service shall have brass or cast iron body, Y-or angle-pattern, cleanable, not less than 60-mesh noncorroding screen of an area to provide net free area not less than ten times the pipe diameter with pressure rating compatible with the refrigerant service. Screens shall be stainless steel or monel and reinforced spring-loaded where necessary for bypass proof construction.

2.7.8.6 Brazing Materials

Brazing materials for refrigerant piping shall be in accordance with FS QQ-B-654, Classification BCuP-5.

2.8 FABRICATION

2.8.1 Factory Coating

Unless otherwise specified, equipment and component items, when fabricated from ferrous metal, shall be factory finished with the manufacturer's standard finish. Cut edges of galvanized surfaces where hot-dip galvanized sheet steel is used shall be coated with a zinc-rich coating conforming to ASTM D 520, Type I.

2.8.2 Field Painting

Painting required for surfaces not otherwise specified, and finish painting of items only primed at the factory shall be two coats of exterior oil paint.

2.9 SUPPLEMENTAL COMPONENTS/SERVICES

Supplemental heat pump components are not covered in this specification, but shall be provided as specified with the indicated specifications.

2.9.1 OMITTED

2.9.2 OMITTED

2.9.3 Air Supply and Distribution For Air-Conditioning System

Ductwork, air handling units, terminal units, supply and exhaust fans, air filters, expansion tanks and air separator tanks shall be provided as specified in Section 15895 AIR SUPPLY AND DISTRIBUTION SYSTEM FOR AIR-CONDITIONING SYSTEM.

2.9.4 Testing, Adjusting, and Balancing of HVAC Systems

Testing, adjusting, and balancing of air distribution systems shall be as specified in Section 15990 TESTING, ADJUSTING AND BALANCING OF HVAC SYSTEMS.

2.9.5 OMITTED

2.9.6 Drain Piping

Drain piping systems shall be provided as specified in Section 15400 PLUMBING, GENERAL PURPOSE.

2.9.7 Insulation

Insulation for refrigerant piping shall be provided as specified in Section 15250 THERMAL INSULATION FOR PIPING.

PART 3 EXECUTION

3.1 INSTALLATION

Work shall be installed as indicated and in accordance with the manufacturer's diagrams and recommendations.

3.1.1 Heat Pump System

3.1.1.1 Refrigerant Charging

a. Initial Charge: Upon completion of the refrigerant pipe testing, the vacuum on the system shall be broken by adding the required charge of dry refrigerant for which the system is designed. Contractor shall provide the complete charge of refrigerant in strict accordance with manufacturer's recommendations. Upon satisfactory completion of the system performance tests, any refrigerant that has been lost from the system shall be replaced. After the system is fully operational, all service valve seal caps and blanks over gauge points shall be installed and tightened.

b. Refrigerant Leakage: If a refrigerant leak is discovered after the system has been charged, the leaking portion of the system shall immediately be isolated from the remainder of the system and the refrigerant shall be pumped into the system receiver or other suitable container. Under no circumstances shall the refrigerant be discharged into the atmosphere.

c. Contractor's Responsibility: The Contractor shall, at all times during the installation and testing of the refrigeration system, take steps to prevent the release of refrigerants into the atmosphere. The steps shall include, but not be limited to, procedures which will minimize the release of refrigerants to the atmosphere and the use of refrigerant recovery devices to remove refrigerant from the system and store the refrigerant for reuse or reclaim. At no time shall more than 3 oz. of refrigerant be released to the atmosphere in any one occurrence. Any system leaks within the first year shall be repaired in accordance with the requirements herein at no cost to the Government including material, labor, and refrigerant if the leak is the result of defective equipment, material, or installation.

3.1.1.2 Oil Charging

Two complete charges of lubricating oil for each compressor crankcase shall be furnished. One charge shall be used during the performance testing period, and upon the satisfactory completion of the tests, the oil shall be drained and replaced with the second charge.

3.1.2 Refrigerant Piping

Unless otherwise specified, pipe and fittings installation shall conform to requirements of ASME B31.5. Pipe shall be cut accurately to measurement established at the jobsite and worked into place without springing or forcing. Cutting or otherwise weakening of the building structure to facilitate piping installation will not be permitted without written approval. Pipes shall be cut square, shall have burrs removed by reaming, and shall be installed in a manner to permit free expansion and contraction without damage to joints or hangers. Filings, dust, or dirt shall be wiped from interior of pipe before connections are made.

3.1.2.1 Directional Changes

Changes in direction shall be made with fittings, except that bending of pipe 4 inches and smaller will be permitted, provided a pipe bender is used and wide-sweep bends are formed. The centerline radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, or other malformations will not be accepted.

3.1.2.2 Functional Requirements

Piping shall be installed 1/2 inch per 10 feet of pipe in the direction of flow to ensure adequate oil drainage. Open ends of refrigerant lines or equipment shall be properly capped or plugged during installation to keep moisture, dirt, or other foreign material out of the system. Piping shall remain capped until installation. Equipment piping shall be in accordance with the equipment manufacturer's recommendations and the contract drawings.

3.1.2.3 Brazed Joints

Before brazing copper joints, both the outside of the tube and the inside of the fitting shall be cleaned with a wire fitting brush until the entire joint surface is bright and clean. Brazing flux shall not be used. Surplus brazing material shall be removed at all joints. Steel tubing joints shall be made in accordance with the manufacturer's recommendations. Joints in steel tubing shall be painted with the same material as the baked-on coating within 8 hours after joints are made. Tubing shall be protected against oxidation during brazing by continuous purging of the inside of the piping using nitrogen. All piping shall be supported prior to brazing and shall not be sprung or forced.

3.1.2.4 Threaded Joints

Threaded joints shall be made with tapered threads and made tight with PTFE tape complying with ASTM D 3308 or equivalent thread-joint compound applied to the male threads only. Not more than three threads shall show after the joint is made.

3.1.2.5 Welded Joints

Welding shall be in accordance with qualified procedures using qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPV IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.1. Contracting Officer shall be notified 24 hours in advance of welding tests and the tests shall be performed at the work site if practical. A permanent mark shall be applied near each weld to identify the welder who made that weld. Welded joints in steel refrigerant piping shall be fusion-welded. Changes in direction of piping shall be made with welded fittings only; mitering or notching pipe or other similar construction to form elbows or tees will not be permitted. Branch connections shall be made with welding tees or forged welding branch outlets. Steel pipe shall be thoroughly cleaned of all scale and foreign matter before the piping is assembled. During welding the pipe and fittings shall be filled with an inert gas, such as nitrogen, to prevent the formation of scale. Beveling, alignment, heat treatment, and inspection of weld shall conform to ASME B31.1. Weld defects shall be removed and rewelded at no additional cost to the Government. Electrodes shall be stored and dried in accordance with AWS D1.1 or as recommended by the manufacturer. Electrodes that have been wetted or that have lost any of their coating shall not be used.

3.1.2.6 Flanged Joints

Flanged joints shall be faced true, provided with gaskets suitable for use with refrigerants and made square and tight. When steel refrigerant piping is used, union or flange joints shall be provided in each line immediately preceding the connection to each piece of equipment requiring maintenance, such as compressors, coils, chillers, control valves, and other similar items.

3.1.2.7 Flared Connections

When flared connections are used, a suitable lubricant shall be used between the back of the flare and the nut in order to avoid tearing the flare while tightening the nut.

3.1.3 Refrigerant Valves and Components

3.1.3.1 Valves

a. Stop valves shall be installed on each side of each piece of equipment such as compressors condensers, evaporators, receivers, and other similar items in multiple-unit installation, to provide partial system isolation as required for maintenance or repair. Angle and globe valves shall be installed with stems horizontal unless otherwise indicated. Ball valves shall be installed with stems positioned to facilitate operation and maintenance.

b. Expansion valves shall be installed with the thermostatic expansion valve bulb located on top of the suction line when the suction line is less than 2 inches in diameter and at the 4 o'clock or 8 o'clock position on lines larger than 2 inches. The bulb shall be securely fastened with two clamps. The bulb shall be insulated. The bulb shall be installed in a horizontal portion of the suction line, if possible, with the pigtail on the bottom. If the bulb must be installed in a vertical line, the bulb tubing shall be facing up.

3.1.3.2 Vibration Dampers

Vibration damper shall be provided in the suction and discharge lines on spring mounted compressors. Vibration dampers shall be installed parallel with the shaft of the compressor and shall be anchored firmly at the upstream end on the suction line and the downstream end in the discharge line.

3.1.3.3 Strainers

Strainers shall be provided immediately ahead of all solenoid valves and expansion devices. Strainers may be an integral part of the expansion valve.

3.1.3.4 Filter Dryer

A liquid line filter dryer shall be provided on each refrigerant circuit located such that all liquid refrigerant passes through a filter dryer. The filter dryer shall be sized in accordance with the manufacturers recommendations for the system in which it is installed. The filter dryer shall be installed such that the filter dryer can be isolated from the system, the isolated portion of the system evacuated, and the filter dryer replaced. Filter dryers shall be installed in the horizontal position except replaceable core filter dryers may be installed in the vertical position with the access flange on the bottom.

3.1.3.5 Sight Glass

A moisture indicating sight glass shall be installed in all refrigerant circuits down stream of all filter dryers.

3.1.3.6 Discharge Line Oil Separator

Discharge line oil separator shall be provided in the discharge line from each compressor. Oil return line shall be connected to the compressor as recommended by the compressor manufacturer.

3.1.3.7 Accumulator

Accumulators shall be provided in the suction line to each compressor.

3.1.3.8 Refrigerant Pipe Insulation

Refrigerant pipe handling liquid or gas refrigerant 60 degrees F or below shall require insulation. This applies to both the heating and cooling cycles of the heat pump.

3.1.4 Refrigerant Piping Accessories

3.1.4.1 Supports

a. General: All refrigerant pipe supports shall be in accordance with ASME B31.5. Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion

movement, and to prevent buckling, swaying, and undue strain. All piping subjected to vertical movement, when operating temperatures exceed ambient temperatures, shall be supported by variable spring hangers and supports or by constant support hangers. Structural steel required for reinforcement to properly support piping, headers, and equipment but not shown shall be provided under this section.

3.1.4.2 OMITTED

3.1.4.3 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein. Pipe hanger types 5, 12, and 26 shall not be used.

- a. Hangers: Type 3 shall not be used on insulated piping.
- b. Inserts: Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustments may be used if they otherwise meet the requirements for Type 18 inserts.
- c. C-Clamps: Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and have both locknuts and retaining devices, furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.
- d. Angle Attachments: Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.
- e. Hangers: Type 24 may be used only on trapeze hanger systems or on fabricated frames.
- f. Saddles and Shields: Where Type 39 saddle or Type 40 shield are permitted for a particular pipe attachment application, the Type 39 saddle, connected to the pipe, shall be used on all pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher. Type 40 shields shall be used on all piping less than 4 inches and all piping 4 inches and larger carrying medium less than 60 degrees F. A high density insulation insert of cellular glass shall be used under the Type 40 shield for piping 2 inches and larger.
- g. Horizontal Pipe Supports: Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves. Pipe hanger loads suspended from steel joist with hanger loads between panel points in excess of 50 pounds shall have the excess hanger loads suspended from panel points.
- h. Vertical Pipe Supports: Vertical pipe shall be supported at each floor, except at slab-on-grade, and at intervals of not more than 15 feet, not more than 8 feet from end of risers, and at vent terminations.
- i. Pipe Guides: Type 35 guides using, steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided where required to allow longitudinal pipe movement. Lateral restraints shall be provided as required. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered.
- j. Steel Slides: Where steel slides do not require provisions for restraint of lateral movement, an alternate guide method may be used. On piping 4 inches and larger, a Type 39 saddle shall be used. On piping under 4 inches, a Type 40 protection shield shall be used. Piping 4 inches and larger carrying medium less than 60 degrees F, a Type 40 protection shield shall be used. A high density insulation insert of density 8 pcf or greater shall be used under all shields on piping 2 inches and larger.
- k. High Temperature Pipe: Where there are high system temperatures and welding to piping is not desirable, the Type 35 guide shall include a pipe cradle, welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 4 inches, or by an amount adequate for the insulation, whichever is greater.

1. Multiple Pipe Runs: In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run.

3.1.4.4 Anchors

Anchors shall be provided wherever necessary or indicated to localize expansion or to prevent undue strain on piping. Anchors shall consist of heavy steel collars with lugs and bolts for clamping and attaching anchor braces, unless otherwise indicated. Anchor braces shall be installed in the most effective manner to secure the desired results using turnbuckles where required. Supports, anchors, or stays shall not be attached where they will injure the structure or adjacent construction during installation or by the weight of expansion of the pipeline. Detailed drawings of pipe anchors shall be submitted for approval before installation.

3.1.4.5 Pipe Alignment Guides

Pipe alignment guides shall be provided where indicated for expansion loops, offsets, and bends and as recommended by the manufacturer. For expansion joints, guides shall be placed not to exceed 5 feet on each side of each joint on lines greater than 4 inches. For lines 4 inches or smaller, guides shall be placed not to exceed 2 feet on each side of each joint.

3.1.4.6 Pipe Sleeves

Sleeves shall not be installed in structural members except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective wall, floor, or roof, and shall be cut flush with each surface. Pipes passing through concrete or masonry wall or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Unless otherwise indicated, sleeves shall provide a minimum of 1/4 inch all-around clearance between bare pipe and sleeves or between jacketed-insulation and sleeves. Sleeves in bearing walls, waterproofing membrane floors, and wet areas shall be steel pipe or cast iron pipe. Sleeves in nonbearing walls, floors, or ceilings may be steel pipe, cast iron pipe, galvanized sheet metal with lock-type longitudinal seam and of the metal thickness indicated, or moisture resistant fiber or plastic. Except in pipe chases or interior walls, the annular space between pipe and sleeve or between jacket over-insulation and sleeve shall be sealed as indicated and specified in Section 07920 CAULKING AND SEALANTS. Pipes passing through wall waterproofing membrane shall be sleeved as specified above, and a waterproofing clamping flange shall be installed.

a. Roof and Floor Penetrations: Pipes passing through roof or floor waterproofing membrane shall be installed through a 4-pound lead flashing sleeve, a 17-ounce copper sleeve, or a 0.032-inch thick aluminum sleeve, each within an integral skirt or flange. Flashing sleeve shall be suitably formed, and skirt or flange shall extend not less than 8 inches from the pipe and shall be set over the roof or floor membrane in a troweled coating of bituminous cement. The flashing sleeve shall extend up the pipe a minimum of 2 inches above highest floor level of the roof or a minimum of 10 inches above the roof, whichever is greater, or 10 inches above the floor. The annular space between the flashing sleeve and the bare pipe or between the flashing sleeve and the metal-jacket-covered insulation shall be sealed as indicated. Pipes up to and including 10 inches in diameter passing through roof or floor waterproofing membrane may be installed through a cast iron sleeve with caulking recess, anchor lugs, flashing clamp device, and pressure ring with brass bolts. Waterproofing membrane shall be clamped into place and sealant shall be placed in the caulking recess. In lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve or conduit and sleeve, a modular mechanical type sealing assembly may be installed. Seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe/conduit and sleeve with corrosion protected carbon steel bolts, nuts, and pressure plates. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe/conduit seal and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe/conduit and sleeve involved. The Contractor electing to use the modular mechanical type seals shall provide sleeves of the proper diameters.

b. Fire-Rated Walls, Floors, and Partitions: Penetration of all fire-rated walls, floors, and partitions shall be sealed as specified in Section 07270 FIRESTOPPING.

3.1.4.7 Escutcheons

Finished surfaces where exposed piping, bare or insulated, pass through floors, walls, or ceilings, except in boiler, utility, or equipment rooms, shall be provided with escutcheons. Where sleeves project slightly from floors, special deep-type escutcheons shall be used. Escutcheon shall be secured to pipe or pipe covering.

3.1.4.8 Access Panels

Access panels shall be provided for all concealed valves, vents, controls, and items requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced and maintained or completely removed and replaced.

3.1.5 Mechanical Room Ventilation

Mechanical rooms containing a central refrigerated air-conditioning system shall be ventilated to the outdoors. The ventilation system shall be in accordance with Section 15895 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

3.2 TESTS

Tests shall be conducted in the presence of the Contracting Officer. Water and electricity required for the tests will be furnished by the Government. Any material, equipment, instruments, and personnel required for the test shall be provided by the Contractor. The services of a qualified technician shall be provided as required to perform all tests and procedures indicated herein.

3.2.1 Refrigerant Pipe Testing

a. Refrigerant Leakage Test: After all components of the refrigerant system have been installed and the piping connected, the system shall be subjected to a refrigerant leakage test. The refrigerant leakage test shall be done with dry nitrogen before any refrigerant pipe is insulated or covered. High and low side of the refrigerant system shall be tested for the minimum refrigerant leakage test pressure specified in ASHRAE 15, for the refrigerant employed in the system. System shall be proved tight and free of leaks by allowing the refrigerant leakage test pressure to remain on the system for 24 hours with no drop in pressure. The initial test pressure and surrounding air temperature will be recorded. After the 24 hour hold period, the final system pressure and surrounding air temperature will be recorded. A correction of 0.3 psi will be allowed for each degree F change in the initial and final temperature of the surrounding air, plus for an increase and minus for a decrease. The system will have passed the refrigerant leakage test if the corrected final system pressure is exactly equal to the initial system test pressure. If the pressures are not equal, the leaks shall be located and repaired.

b. Refrigerant Leaks: To repair leaks, the joint shall be taken apart, thoroughly cleaned, and remade as a new joint. Joints repaired by caulking or remelting and adding more brazing material will not be acceptable. After leak repairs have been made, the refrigerant leakage test shall be conducted again.

c. Evacuation Test: After the foregoing tests have been satisfactorily completed and the pressure relieved, the entire system shall be evacuated to an absolute pressure of 0.02 inch of Hg. During evacuation of the system, the ambient outdoor temperature shall be above 35 degrees F. The vacuum line shall be closed, and the system shall stand for 12 hours. After this period, the increase in absolute pressure shall not exceed 0.004 inch of Hg. During this test, pressures shall be recorded by a thermocouple-type, electronic-type, or calibrated micron gauge.

3.2.2 System Performance Tests

Upon completion and prior to acceptance of the system, the Contractor shall subject the heat pump system to such tests to demonstrate that all components of the heat pump system perform together as integral parts of the system. The tests may, at the manufacturer's option, consist of individual component tests or tests of completely assembled units. Corrections and adjustments shall be made as necessary to produce the capacities and design conditions indicated. Test shall be conducted by a qualified test engineer at such times as directed. Indicating instruments shall be read at half-hour intervals, unless otherwise directed. Tests shall cover a period of not less than two days for heating and cooling seasons for each system tested. Test reports shall include the following applicable specified information together with conclusions as to the adequacy of the system:

- a. Date and time with outside weather conditions.
- b. Load on the system.
- c. Air quantity and conditions on all air coils.
- d. Water quantity and temperature on all water coils.
- e. Capacity loading conditions of the compressor(s).
- f. Refrigerant condensing temperature and pressure.
- g. Refrigerant suction temperature and pressure.
- h. Running current of all motors.
- i. The actual on-site setting of all operating and safety controls.
- j. The refrigerant used in the system.

The above information shall be taken at least three different times at outside dry bulb temperatures that are at least 5 degrees F apart.

3.3 CLEANING AND ADJUSTING

3.3.1 Piping

Pipes shall be cleaned free of scale and thoroughly flushed of all foreign matter. A temporary bypass shall be provided for all water coils to prevent flushing water from passing through coils. Strainers and valves shall be thoroughly cleaned. Prior to testing and balancing, air shall be removed from all water systems by operating the air vents. Temporary measures, such as piping the overflow from vents to a collecting vessel shall be taken to avoid water damage during the venting process. Air vents shall be plugged or capped after the system has been vented.

3.3.2 Miscellaneous Equipment

Equipment shall be wiped clean, with all traces of oil, dust, dirt, or paint spots removed. Temporary filters shall be provided for all fans that are operated during construction, and new filters shall be installed after all construction dirt has been removed from the building. System shall be maintained in this clean condition until final acceptance. Bearings shall be properly lubricated with oil or grease as recommended by the manufacturer. Belts shall be tightened to proper tension. Control valves and other miscellaneous equipment requiring adjustment shall be adjusted to setting indicated or directed. Fans shall be adjusted to the speed indicated by the manufacturer to meet specified conditions.

(END OF SECTION)

SECTION 15895**AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM****PART 1 GENERAL****1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

- | | |
|-----------------|---|
| ARI 410 | (1991) Forced-Circulation Air-Cooling and Air-Heating Coils |
| ARI 430 | (1989) Central-Station Air-Handling Units |
| ARI Guideline D | (1987) Application and Installation of Central Station Air-Handling Units |

AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

- | | |
|----------|--|
| AMCA 210 | (1985) Laboratory Methods of Testing Fans for Rating |
|----------|--|

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABEMA)

- | | |
|----------|--|
| ABEMA 9 | (1990) Load Ratings and Fatigue Life for Ball Bearings |
| ABEMA 11 | (1990) Load Ratings and Fatigue Life for Roller Bearings |

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- | | |
|------------|---|
| ASTM A 47 | (1990) Ferritic Malleable Iron Castings |
| ASTM A 53 | (1993a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless |
| ASTM A 106 | (1993) Seamless Carbon Steel Pipe for High-Temperature Service |
| ASTM A 123 | (1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products |
| ASTM A 167 | (1993) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip |
| ASTM A 181 | (1993a) Forgings, Carbon Steel, for General-Purpose Piping |
| ASTM A 183 | (1983; R 1990) Carbon Steel Track Bolts and Nuts |
| ASTM A 193 | (1993a) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service |
| ASTM A 525 | (1993) General Requirement for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process |
| ASTM A 536 | (1984; R 1993) Ductile Iron Castings |

ASTM A 733	(1989) Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM B 117	(1994) Salt Spray (Fog) Testing
ASTM C 107	(1989) Panel Spalling Testing High-Duty Fireclay Brick
ASTM C 1071	(1991) Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material)
ASTM D 520	(1984; R 1989) Zinc Dust Pigment
ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 2000	(1990) Rubber Products in Automotive Applications
ASTM D 3359	(1993) Measuring Adhesion by Tape Test

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 52.1	(1992) Gravimetric and Duct-Spot Procedures for Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter
-------------	--

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)
ASME B16.3	(1992) Malleable Iron Threaded Fittings
ASME B16.5	(1988; Errata; B16.5a) Pipe Flanges and Flanged Fittings
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.39	(1986) Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300
ASME B31.1	(1992; B31.1a; B31.1b) Power Piping
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C606	(1987) Grooved and Shouldered Joints
-----------	--------------------------------------

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-25	(1993) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1991) Pipe Hangers and Supports - Selection and Application
MSS SP-70	(1990) Cast Iron Gate Valves, Flanged and Threaded Ends

MSS SP-71	(1990) Cast Iron Swing Check Valves, Flanged and Threaded Ends
MSS SP-80	(1987) Bronze Gate, Globe, Angle and Check Valves
MSS SP-85	(1994) Cast Iron Globe & Angle Valves, Flanged and Threaded Ends

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(1993) Motors and Generators
-----------	------------------------------

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	(1993) Installation of Air Conditioning and Ventilating Systems
----------	---

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA-06	(1985) HVAC Duct Construction Standards - Metal and Flexible
-----------	--

UNDERWRITERS LABORATORIES (UL)

UL-01	(1994; Supple) Building Materials Directory
UL 214	(1993) Tests for Flame-Propagation of Fabrics and Films
UL 586	(1990) High-Efficiency, Particulate, Air Filter Units
UL 900	(1994) Test Performance of Air Filter Units

1.2 COORDINATION OF TRADES

Ductwork, piping offsets, fittings, and accessories shall be furnished as required to provide a complete installation and to eliminate interference with other construction.

1.3 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

1.4 SUBMITTALS

The following shall be submitted for Government approval:

1.4.1 Data

1.4.1.1 Components and Equipment Data;

Manufacturer's catalog data shall be included with the detail drawings for the following items. The data shall be highlighted to show model, size, options, etc., that are intended for consideration. Data shall be adequate to demonstrate compliance with contract requirements for the following:

- a. Air Systems Equipment
- b. Air Handling Units

1.4.2 Statements

1.4.2.1 Similar Services;

Statement demonstrating successful completion of similar services on at least 5 projects of similar size and scope, at least 2 weeks prior to submittal of other items required by this section.

1.4.3 Reports

1.4.3.1 Test Reports;

Test reports for the performance tests in booklet form, upon completion of testing. Reports shall document phases of tests performed including initial test summary, repairs/adjustments made, and final test results.

1.4.4 Operation and Maintenance Manuals

1.4.4.1 Air Supply, Distribution, Ventilation, and Exhaust Manuals;

Six manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance. The manuals shall include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Components and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of products that are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 2 years before bid opening. The 2-year experience shall include applications of components and equipment under similar circumstances and of similar size. The 2 years must be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. The equipment items shall be supported by a service organization.

2.2 ASBESTOS PROHIBITION

Asbestos and asbestos-containing products shall not be used.

2.3 NAMEPLATES

Equipment shall have a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, and catalog number.

2.4 EQUIPMENT GUARDS AND ACCESS

Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact shall be fully enclosed or guarded according to OSHA requirements. High temperature equipment and piping exposed to contact by personnel or where it creates a potential fire hazard shall be properly guarded or covered with insulation of a type specified.

2.5 PIPING COMPONENTS

2.5.1 Steel Pipe

Steel pipe shall conform to ASTM A 53, Schedule 40, Grade A or B, Type E or S.

2.5.2 Joints and Fittings For Steel Pipe

Joints shall be welded, flanged, threaded, or grooved as indicated. If not otherwise indicated, piping 1 inch and smaller shall be threaded; piping larger than 1 inch and smaller than 3 inches shall be either threaded, grooved, or welded; and piping 3 inches and larger shall be grooved, welded, or flanged. Rigid grooved mechanical joints and fittings may only be used in serviceable aboveground locations where the temperature of the circulating medium does not exceed 230 degrees F. Flexible grooved joints shall be used only as a flexible connector with grooved pipe system. Unless otherwise specified, grooved piping components shall meet the corresponding criteria specified for the similar welded, flanged, or threaded component specified herein. The manufacturer of each fitting shall be permanently identified on the body of the fitting according to MSS SP-25.

2.5.2.1 Omitted

2.5.2.2 Flanged Joints and Fittings

Flanges shall conform to ASTM A 181 and ASME B16.5, Class 150. Gaskets shall be nonasbestos compressed material according to ASME B16.21, 1/16 inch thickness, full face or self-centering flat ring type. The gaskets shall contain aramid fibers bonded with styrene butadiene rubber (SBR) or nitrile butadiene rubber (NBR). Bolts, nuts, and bolt patterns shall conform to ASME B16.5. Bolts shall be high or intermediate strength material conforming to ASTM A 193.

2.5.2.3 Threaded Joints and Fittings

Threads shall conform to ASME B1.20.1. Unions shall conform to ASME B16.39, Class 150. Nipples shall conform to ASTM A 733. Malleable iron fittings shall conform to ASME B16.3, type as required to match piping.

2.5.2.4 Dielectric Unions and Flanges

Dielectric unions shall have the tensile strength and dimensional requirements specified. Unions shall have metal connections on both ends threaded to match adjacent piping. Metal parts of dielectric unions shall be separated with a nylon insulator to prevent current flow between dissimilar metals. Unions shall be suitable for the required operating pressures and temperatures. Dielectric flanges shall provide the same pressure ratings as standard flanges and provide complete electrical isolation.

2.5.2.5 Grooved Mechanical Joints and Fittings

Joints and fittings shall be designed for not less than 125 psig service and shall be the product of the same manufacturer. Fitting and coupling houses shall be malleable iron conforming to ASTM A 47, Grade 32510; ductile iron conforming to ASTM A 536, Grade 65-45-12; or steel conforming to ASTM A 106, Grade B or ASTM A 53. Gaskets shall be molded synthetic rubber with central cavity, pressure responsive configuration and shall conform to ASTM D 2000 Grade No. 2CA615A15B44F17Z for circulating medium up to 230 degrees F or Grade No. M3BA610A15B44Z for circulating medium up to 200 degrees F. Grooved joints shall conform to AWWA C606. Coupling nuts and bolts shall be steel and shall conform to ASTM A 183.

2.5.3 Omitted

2.5.4 Omitted

2.5.5 Valves

Valves shall be Class 125 and shall be suitable for the intended application. Valves shall meet the material, fabrication and operating requirements of ASME B31.1. Chain operators shall be provided for valves located 10 feet or higher above the floor. Valves in sizes larger than 1 inch and used on steel pipe systems, may be provided with rigid grooved mechanical joint ends. Such grooved end valves shall be subject to the same requirements as rigid grooved mechanical joints and fittings and, shall be provided by the same manufacturer as the grooved pipe joint and fitting system.

2.5.5.1 Gate Valves

Gate valves 2-1/2 inches and smaller shall conform to MSS SP-80 and shall be bronze with rising stem and threaded, solder, or flanged ends. Gate valves 3 inches and larger shall conform to MSS SP-70 and shall be cast iron with bronze trim, outside screw and yoke, and flanged or threaded ends.

2.5.5.2 Globe Valves

Globe valves 2-1/2 inches and smaller shall conform to MSS SP-80, bronze, threaded, soldered, or flanged ends. Globe valves 3 inches and larger shall conform to MSS SP-85 and shall be cast iron with bronze trim and flanged, or threaded ends.

2.5.5.3 Check Valves

Check valves 2-1/2 inches and smaller shall conform to MSS SP-80 and shall be bronze with threaded, soldered, or flanged ends. Check valves 3 inches and larger shall conform to MSS SP-71 and shall be cast iron with bronze trim and flanged or threaded ends.

2.5.5.4 Angle Valves

Angle valves 2-1/2 inches and smaller shall conform to MSS SP-80 and shall be bronze with threaded, soldered, or flanged ends. Angle valves 3 inches and larger shall conform to MSS SP-85 and shall be cast iron with bronze trim and flanged, or threaded ends.

2.5.5.5 Omitted

2.5.5.6 Butterfly Valves

Butterfly valves shall be 2 flange or lug wafer type, and shall be bubble-tight at 150 psig. Valve bodies shall be cast iron, malleable iron, or steel. ASTM A 167, Type 404 or Type 316, corrosion resisting steel stems, bronze or corrosion resisting steel discs, and synthetic rubber seats shall be provided. Valves smaller than 8 inches shall have throttling handles with a minimum of seven locking positions. Valves 8 inches and larger shall have totally enclosed manual gear operators with adjustable balance return stops and position indicators. Valves in insulated lines shall have extended neck to accommodate insulation thickness.

2.5.6 Omitted

2.5.7 Heat Pump System Accessories

Heat Pump System Accessories as indicated in Section 15775 FIELD – ERECTED HEAT PUMP SYSTEM.

2.5.8 Omitted

2.5.9 Omitted

2.5.10 Omitted

2.5.11 Flexible Pipe Connectors

Flexible pipe connectors shall be designed for 125 psi or 150 psi service as appropriate for the static head plus the system head, and 250 degrees F, 230 degrees F for grooved end flexible connectors.

The flexible section shall be constructed of rubber, tetrafluoroethylene resin, or corrosion-resisting steel, bronze, monel, or galvanized steel. The flexible section shall be suitable for intended service with end connections to match adjacent piping. Flanged assemblies shall be equipped with limit bolts to restrict maximum travel to the manufacturer's standard limits. Unless otherwise indicated, the length of the flexible connectors shall be as recommended by the manufacturer for the service intended. Internal sleeves or liners, compatible with circulating medium, shall be provided when recommended by the manufacturer. Covers to protect the bellows shall be provided where indicated.

2.5.12 Pressure Gauges

Gauges shall conform to ASME B40.1 and shall be provided with throttling type needle valve or a pulsation dampener and shut-off valve. Gauge shall be a minimum of 3-1/2 inches in diameter and shall have a range from 0 psig to approximately 1.5 times the maximum system working pressure.

2.5.13 Thermometers

Thermometers shall have brass, malleable iron, or aluminum alloy case and frame, clear protective face, permanently stabilized glass tube with indicating-fluid column, white face, black numbers, and a 9 inch scale, and shall have rigid stems with straight, angular, or inclined pattern.

2.5.14 Escutcheons

Escutcheons shall be chromium-plated iron or chromium-plated brass, either one piece or split pattern, held in place by internal spring tension or setscrews.

2.5.15 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69.

2.5.16 Omitted

2.5.17 Insulation

Shop and field applied insulation shall be as specified in Section 15250 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.5.18 Condensate Drain Lines

Condensate drainage shall be provided for each item of equipment that generates condensate as specified for drain, waste, and vent piping systems in Section 15400 PLUMBING, GENERAL PURPOSE.

2.6 ELECTRICAL WORK

Electrical motor-driven equipment specified shall be provided complete with motor, motor starter, and controls. Unless otherwise specified, electric equipment, including wiring and motor efficiencies, shall be according to Section 16415 ELECTRICAL WORK, INTERIOR. Electrical characteristics and enclosure type shall be as shown. Unless otherwise indicated, motors of 1 hp and above shall be high efficiency type. Motor starters shall be provided complete with thermal overload protection and other appurtenances necessary. Each motor shall be according to NEMA MG 1 and shall be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Manual or automatic control and protective or signal devices required for the operation specified, and any control wiring required for controls and devices, but not shown, shall be provided.

2.7 CONTROLS

Controls shall be provided as specified in Section 15950 HEATING, VENTILATING AND AIR CONDITIONING (HVAC) CONTROL SYSTEMS.

2.8 DUCTWORK COMPONENTS

2.8.1 Metal Ductwork

All aspects of metal ductwork construction, including all fittings and components, shall comply with SMACNA-06 unless otherwise specified. Elbows shall be radius type with a centerline radius of 1-1/2 times the width or diameter of the duct where space permits. Otherwise, elbows having a minimum radius equal to the width or diameter of the duct or square elbows with factory fabricated turning vanes may be used. Static pressure Class 1/2, 1, and 2 inch w.g. ductwork shall meet the requirements of Seal Class C. Sealants shall conform to fire hazard classification specified in Section 15250 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Pressure sensitive tape shall not be used as a sealant. Outdoor air intake ducts and plenums shall be fabricated with watertight soldered or brazed joints and seams.

2.8.1.1 Transitions

Diverging air flow transitions shall be made with each side pitched out a maximum of 15 degrees, for an included angle of 30 degrees. Transitions for converging air flow shall be made with each side pitched in a maximum of 30 degrees, for an included angle of 60 degrees, or shall be as indicated. Factory-fabricated reducing fittings for systems using round duct sections when formed to the shape of the ASME short flow nozzle, need not comply with the maximum angles specified.

2.8.1.2 Omitted

2.8.1.3 Omitted

2.8.1.4 General Service Duct Connectors

A flexible duct connector approximately 6 inches in width shall be provided where sheet metal connections are made to fans or where ducts of dissimilar metals are connected. For round/oval ducts, the flexible material shall be secured by stainless steel or zinc-coated, iron clinch-type draw bands. For rectangular ducts, the flexible material locked to metal collars shall be installed using normal duct construction methods. The composite connector system shall comply with UL 214 and be classified as "flame-retarded fabrics" in UL-01.

2.8.2 Omitted

2.8.3 Omitted

2.8.4 Omitted

2.8.5 Plenums and Casings for Field-Fabricated Units

2.8.5.1 Plenum and Casings

Plenums and casings shall be fabricated and erected as shown in SMACNA-06, as applicable. Unless otherwise indicated, system casing shall be constructed of not less than 16 gauge galvanized sheet steel. Cooling coil drain pans with 1 inch threaded outlet shall be provided to collect condensation from the cooling coils. Drain pans shall be fabricated of not lighter than 16 gauge steel, galvanized after fabrication or of 18 gauge corrosion-resisting sheet steel conforming to ASTM A 167, Type 304, welded and stiffened. Drain pans exposed to the atmosphere shall be thermally insulated to prevent condensation. Insulation shall be coated with a flame resistant waterproofing

material. Separate drain pans shall be provided for each vertical coil section, and a separate drain line shall be provided for each pan. Pans shall be generously sized to ensure capture of entrained moisture on the downstream-air side of the coil. Openings in the casing, such as for piping connections, shall be sealed and covered to prevent air leakage. Water seal for the drain shall provide at least 2 inch water gauge greater than the maximum negative pressure in the coil space.

2.8.5.2 Casing

Casings shall be terminated at the curb line and anchored by the use of galvanized angle iron sealed and bolted to the curb, as indicated in SMACNA-06.

2.8.5.3 Access Doors

Access doors shall be provided in each section of the casing. Door frames shall be welded in place, and each door shall be neoprene gasketed, hinged with minimum of two brass hinges, and fastened with a minimum of two brass tension fasteners operable from outside of the casing. Where possible, doors shall be 36 by 18 inches located 18 inches above the floor. Where the space available will not accommodate doors of this size, doors as large as the space will accommodate shall be provided. Doors shall swing so that fan suction or pressure holds door in closed position, and shall be airtight.

2.8.5.4 Factory-Fabricated Insulated Sheet Metal Panels

Factory-fabricated components may be used for field-assembled units, provided all requirements specified for field-fabricated plenums and casings are met. Panels shall be of modular design, prettested for structural strength, thermal control, condensation control, and acoustical control. Panel joints shall be sealed and insulated access doors shall be provided and gasketed to prevent air leakage. Panel construction shall be not less than 20 gauge galvanized sheet steel and shall be assembled with fasteners treated against corrosion. Standard length panels shall deflect not more than 1/2 inch under operation. Details of construction, including joint sealing, not specifically covered shall be as indicated in SMACNA-06. The plenums and casings shall be constructed to withstand the specified internal pressure of the air systems.

2.8.5.5 Duct Liner

Unless otherwise specified, duct liner shall conform to ASTM C 1071, Type I or II.

2.9 AIR SYSTEMS EQUIPMENT

2.9.1 Fans

Fans shall be tested and rated according to AMCA 210. Fans may be connected to the motors either directly or indirectly with V-belt drive. V-belt drives shall be designed for not less than 140 percent of the connected driving capacity. Motor sheaves shall be variable pitch for 15 hp and below and fixed pitch as defined by ARI Guideline D. Variable pitch sheaves shall be selected to drive the fan at a speed which will produce the specified capacity when set at the approximate midpoint of the sheave adjustment. When fixed pitch sheaves are furnished, a replaceable sheave shall be provided when needed to achieve system air balance. Motors for V-belt drives shall be provided with adjustable rails or bases. Removable metal guards shall be provided for all exposed V-belt drives, and speed-test openings shall be provided at the center of all rotating shafts. Fans shall be provided with personnel screens or guards on both suction and supply ends, except that the screens need not be provided, unless otherwise indicated, where ducts are connected to the fan. Fan and motor assemblies shall be provided with vibration-isolation supports or mountings. Vibration-isolation units shall be standard products with published loading ratings. Each fan shall be selected to produce the capacity required at the fan static pressure indicated.

2.9.1.1 Centrifugal Fans

Centrifugal fans shall be fully enclosed, single-width single-inlet, or double-width double-inlet, AMCA Pressure Class I, II, or III as required or indicated for the design system pressure. Impeller wheels shall be rigidly constructed, accurately balanced both statically and dynamically. Fan blades may be forward curved, backward-inclined or airfoil design in wheel sizes up to 30 inches. Fan blades for wheels over 30 inches in diameter shall be backward-inclined or airfoil design. Fan wheels over 36 inches in diameter shall have overhung pulleys and a bearing on each side of the wheel. Fan wheels 36 inches or less in diameter may have one or more extra long bearings between the fan wheel and the drive. Bearings shall be sleeve type, self-aligning and self-oiling with oil reservoirs, or precision self-aligning roller or ball-type with accessible grease fittings or permanently lubricated type. Grease fittings shall be connected to tubing and serviceable from a single accessible point. Bearing life shall be L50 rated at not less than 200,000 hours as defined by ABEMA 9 and ABEMA 11. Fan shafts shall be steel, accurately finished, and shall be provided with key seats and keys for impeller hubs and fan pulleys. Each fan outlet shall be of ample proportions and shall be designed for the attachment of angles and bolts for attaching flexible connections. Motors, unless otherwise indicated, shall not exceed 1800 rpm and shall have open enclosures. Motor starters shall be manual, magnetic, across-the-line, or reduced-voltage-start type with general-purpose enclosure.

2.9.2 Coils

Coils shall be fin-and-tube type constructed of seamless copper tubes and aluminum or copper fins mechanically bonded or soldered to the tubes. Copper tube wall thickness shall be a minimum of 0.020 inches. Aluminum fins shall be 0.0055 inch minimum thickness. Copper fins shall be 0.0045 inch minimum thickness. Casing and tube support sheets shall be not lighter than 16 gauge galvanized steel, formed to provide structural strength. When required, multiple tube supports shall be provided to prevent tube sag. Each coil shall be tested at the factory under water at not less than 400 psi air pressure and shall be suitable for 200 psi working pressure. Coils shall be mounted for counterflow service. Coils shall be rated and certified according to ARI 410.

2.9.2.1 Omitted

2.9.2.2 Water Coils

Water coils shall be installed with a pitch of not less than 1/8 inch per foot of the tube length toward the drain end. Headers shall be constructed of cast iron, welded steel or copper. Each coil shall be provided with a plugged vent and drain connection extending through the unit casing.

2.9.3 Air Filters

Air filters shall be listed according to requirements of UL 900, except high efficiency particulate air filters of 99.97 percent efficiency by the DOP Test method shall be as listed under the Label Service and shall meet the requirements of UL 586.

2.9.3.1 Extended Surface Pleated Panel Filters

Filters shall be 2 inch depth, sectional, disposable type of the size indicated and shall have an average efficiency of 25 to 30 percent when tested according to ASHRAE 52.1. Initial resistance at 500 feet per minute shall not exceed 0.36 inches water gauge. Filters shall be UL Class 2. Media shall be nonwoven cotton and synthetic fiber mat. A wire support grid bonded to the media shall be attached to a moisture resistant fiberboard frame. All four edges of the filter media shall be bonded to the inside of the frame to prevent air bypass and increase rigidity.

2.9.3.2 Filter Gauges

Filter gauges shall be dial type, diaphragm actuated draft and shall be provided for all filter stations, including those filters which are furnished as integral parts of factory fabricated air handling units. Gauges shall be at least 3-7/8 inches in diameter, shall have white dials with black figures, and graduations and shall have a minimum range of 1 inch beyond the specified final resistance for the filter bank on which each gauge is applied. Each gauge shall incorporate a screw operated zero adjustment and shall be furnished complete with two static pressure taps with integral compression fittings, two molded plastic vent valves, two 5 foot minimum lengths of 1/4 inch diameter aluminum or vinyl tubing, and all hardware and accessories for gauge mounting.

2.10 AIR HANDLING UNITS

2.10.1 Field-Fabricated Air Handling Units

Built-up units shall be as specified in paragraph DUCTWORK COMPONENTS. Fans, coils spray-coil dehumidifiers, and air filters shall be as specified in paragraph AIR SYSTEMS EQUIPMENT for types indicated.

2.10.2 Factory-Fabricated Air Handling Units

Units shall be single-zone draw-through type or multizone blow-through type as indicated. Units shall include fans, coils, airtight insulated casing and diffuser sections where indicated, adjustable V-belt drives, belt guards for externally mounted motors, access sections where indicated, mixing box or combination sectional filter-mixing box, vibration-isolators, and appurtenances required for specified operation. Each air handling unit shall have physical dimensions suitable to fit space allotted to the unit and shall have the capacity indicated. Air handling unit shall have published ratings based on tests performed according to ARI 430.

2.10.2.1 Casings

Casing sections shall be single wall type constructed of a minimum 18 gauge galvanized steel, or 18 gauge steel outer casing protected with a corrosion resistant paint finish according to paragraph FACTORY PAINTING. Casing shall be designed and constructed with an integral structural steel frame such that exterior panels are non-load bearing. Exterior panels shall be individually removable. Removal shall not affect the structural integrity of the unit. Casings shall be provided with inspection doors, access sections, and access doors as indicated. Inspection and access doors shall be insulated, fully gasketed, double-wall type, of a minimum 18 gauge outer and 20 gauge inner panels. Doors shall be rigid and provided with heavy duty hinges and latches. Inspection doors shall be a minimum 12 inches wide by 12 inches high. Access doors shall be minimum 24 inches wide and shall be the full height of the unit casing or a minimum of 6 ft., whichever is less. Access Sections shall be according to paragraph AIR HANDLING UNITS. Drain pan shall be double-bottom type constructed of 16 gauge galvanized steel, pitched to the drain connection. Drain pans shall be constructed water tight, treated to prevent corrosion, and designed for positive condensate drainage. When 2 or more cooling coils are used, with one stacked above the other, condensate from the upper coils shall not flow across the face of lower coils. Intermediate drain pans or condensate collection channels and downspouts shall be provided, as required to carry condensate to the unit drain pan out of the air stream and without moisture carryover. Each casing section handling conditioned air shall be insulated with not less than 1 inch) thick, 1-1/2 pound density coated fibrous glass material having a thermal conductivity not greater than 0.23 Btu/hr-sf-F. Factory applied fibrous glass insulation shall conform to ASTM C 1071, except that the minimum thickness and density requirements do not apply, and shall meet the requirements of NFPA 90A. Foam-type insulation is not acceptable. Foil-faced insulation shall not be an acceptable substitute for use on double-wall access doors and inspections doors. Duct liner material, coating, and adhesive shall conform to fire-hazard requirements specified in Section 15250 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Exposed insulation edges and joints where insulation panels are butted together shall be protected with a metal nosing strip or shall be coated to conform to meet erosion resistance requirements of ASTM C 107. A latched and hinged inspection door, shall be provided in the fan and coil sections.

2.10.2.2 Heating and Cooling Coils

Coils shall be provided as specified in paragraph AIR SYSTEMS EQUIPMENT, for types indicated.

2.10.2.3 Omitted

2.10.2.4 Air Filters

Air filters shall be as specified in paragraph AIR SYSTEMS EQUIPMENT for types and thickness indicated.

2.10.2.5 Fans

Fans shall be double-inlet, centrifugal type with each fan in a separate scroll. Fans and shafts shall be dynamically balanced prior to installation into air handling unit, then the entire fan assembly shall be statically and dynamically balanced at the factory after it has been installed in the air handling unit. Fans shall be mounted on steel shafts accurately ground and finished. Fan bearings shall be sealed against dust and dirt and shall be precision self-aligning ball or roller type. Bearing life shall be L50 rated at not less than 200,000 hours as defined by ABEMA 9 and ABEMA 11. Bearings shall be permanently lubricated or lubricated type with lubrication fittings readily accessible at the drive side of the unit. Bearings shall be supported by structural shapes, or die formed sheet structural members, or support plates securely attached to the unit casing. Bearings may not be fastened directly to the unit sheet metal casing. Fans and scrolls shall be furnished with coating indicated. Fans shall be driven by a unit-mounted or a floor-mounted motor connected to fans by V-belt drive complete with belt guard for externally mounted motors. Belt guards shall be the three sided enclosed type with solid or expanded metal face. Belt drives shall be designed for not less than a 1.3 service factor based on motor nameplate rating. Motor sheaves shall be variable pitch for 25 hp and below and fixed pitch above 25 hp as defined by ARI Guideline D. Where fixed sheaves are required, variable pitch sheaves may be used during air balance, but shall be replaced with an appropriate fixed sheave after air balance is completed. Variable pitch sheaves shall be selected to drive the fan at a speed that will produce the specified capacity when set at the approximate midpoint of the sheave adjustment. Motors for V-belt drives shall be provided with adjustable bases. Fan motors shall have open enclosures. Unit fan or fans shall be selected to produce the required capacity at the fan static pressure.

2.10.2.6 Access Sections and Filter/Mixing Boxes

Access sections shall be provided where indicated and shall be furnished with access doors as shown. Access sections and filter/mixing boxes shall be constructed in a manner identical to the remainder of the unit casing and shall be equipped with access doors. Mixing boxes shall be designed to minimize air stratification and to promote thorough mixing of the air streams.

2.10.2.7 Diffuser Sections

Diffuser sections shall be furnished between the discharge of all supply fans and cooling coils of blow-through units. Diffuser sections shall be fabricated by the unit manufacturer in a manner identical to the remainder of the unit casing, shall be designed to be airtight under positive static pressures up to 3 inches water gauge and shall have an access door on each side for inspection purposes. Diffuser section shall contain a perforated diffusion plate, fabricated of galvanized steel, Type 316 stainless steel, aluminum, or steel treated for corrosion with manufacturer's standard corrosion-resisting finish. The diffusion plate shall be designed to accomplish uniform air flow across the down-stream coil while reducing the higher fan outlet velocity to within plus or minus 5 percent of the required face velocity of the downstream component.

2.10.2.8 Dampers

Dampers shall be as specified in paragraph CONTROLS.

2.11 FACTORY PAINTING

Units which are not of galvanized construction according to ASTM A 123 or ASTM A 525 shall be factory painted with a corrosion resisting paint finish. Internal and external ferrous metal surfaces shall be cleaned, phosphatised and coated with a paint finish which has been tested according to ASTM B 117, ASTM D 1654, and ASTM D 3359. Evidence of satisfactory paint performance for a minimum of 125 hours for units to be installed indoors and 500 hours for units to be installed outdoors shall be submitted. Rating of failure at the scribe mark shall be not less than 6, average creepage not greater than 1/8 inch. Rating of the inscribed area shall not be less than 10, no failure. On units constructed of galvanized steel which have been welded, exterior surfaces of welds or welds that have burned through from the interior shall receive a final shop docket of zinc-rich protective paint according to ASTM D 520 Type I.

PART 3 EXECUTION

3.1 INSTALLATION

Work shall be installed as shown and according to the manufacturer's diagrams and recommendations.

3.1.1 Piping

Pipe and fitting installation shall conform to the requirements of ASME B31.1. Pipe shall be cut accurately to measurements established at the jobsite, and worked into place without springing or forcing, completely clearing all windows, doors, and other openings. Cutting or other weakening of the building structure to facilitate piping installation will not be permitted without written approval. Pipe or tubing shall be cut square, shall have burrs removed by reaming, and shall permit free expansion and contraction without causing damage to the building structure, pipe, joints, or hangers. Changes in direction shall be made with fittings, except that bending of pipe 4 inches and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The centerline radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be accepted. Horizontal supply mains shall pitch down in the direction of flow as indicated. The grade shall be not less than 1 inch in 40 feet. Reducing fittings shall be used for changes in pipe sizes. Open ends of pipelines and equipment shall be capped or plugged during installation to keep dirt or other foreign materials out of the system. Pipe not otherwise specified shall be uncoated. Connections to appliances shall be made with malleable iron unions for steel pipe 2-1/2 inches or less in diameter, and with flanges for pipe 3 inches and larger. Connections between ferrous and copper piping shall be electrically isolated from each other with dielectric unions or flanges.

3.1.1.1 Joints

a. Threaded Joints: Threaded joints shall be made with tapered threads and made tight with a stiff mixture of graphite and oil or polytetrafluoroethylene tape or equivalent thread joint compound or material, applied to the male threads only.

3.1.1.2 Grooved Mechanical Joints

Grooves shall be prepared according to the coupling manufacturer's instructions. Pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, or narrow-land micrometer. Groove width and dimension of groove from end of pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations.

3.1.1.3 Omitted

3.1.2 Supports

3.1.2.1 General

Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. Piping subjected to vertical movement when operating temperatures exceed ambient temperatures shall be supported by variable spring hangers and supports or by constant support hangers.

3.1.2.2 Omitted

3.1.2.3 Pipe Hangers, Inserts and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69.

a. Insulated Pipe: Insulation on horizontal pipe shall be continuous through hangers for hot and cold piping. Other requirements on insulated pipe are specified in Section 15250 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.1.3 Anchors

Anchors shall be provided wherever necessary or indicated to localize expansion or to prevent undue strain on piping. Anchors shall consist of heavy steel collars with lugs and bolts for clamping and attaching anchor braces, unless otherwise indicated. Anchor braces shall be installed in the most effective manner to secure the desired results using turnbuckles where required. Supports, anchors, or stays shall not be attached where they will injure the structure or adjacent construction during installation or by the weight of expansion of the pipeline.

3.1.4 Pipe Sleeves

Sleeves shall not be installed in structural members except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective wall, floor, or roof, and shall be cut flush with each surface. Pipes passing through concrete or masonry wall or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Unless otherwise indicated, sleeves shall provide a minimum of 1/4 inch all-around clearance between bare pipe and sleeves or between jacket over insulation and sleeves. Sleeves in bearing walls, waterproofing membrane floors, and wet areas shall be steel pipe or cast iron pipe. Sleeves in non-bearing walls, floors, or ceilings may be steel pipe, cast iron pipe, galvanized sheet metal with lock-type longitudinal seam and of the metal thickness indicated, or moisture resistant fiber or plastic. Except in pipe chases or interior walls, the annular space between pipe and sleeve or between jacket over insulation and sleeve, in non-fire rated walls, shall be sealed as indicated and specified in Section 07920 JOINT SEALING. Pipes passing through wall waterproofing membrane shall be sleeved as specified above, and a waterproofing clamping flange shall be installed as indicated.

3.1.4.1 Omitted

3.1.4.2 Fire Seal

Where pipes pass through firewalls, fire partitions, or floors, a fire seal shall be provided as specified in Section 07270 FIRESTOPPING.

3.1.4.3 Escutcheons

Escutcheons shall be provided at finished surfaces where exposed piping, bare or insulated, passes through floors, walls, or ceilings except in boiler, utility, or equipment rooms. Where sleeves project slightly from floors, special deep-type escutcheons shall be used. Escutcheons shall be secured to pipe or pipe covering.

3.1.5 Condensate Drain Lines

Water seals shall be provided in the condensate drain from all units. The depth of each seal shall be 2 inches plus for each the number of inches, measured in water gauge, of the total static pressure rating of the unit to which the drain is connected. Water seals shall be constructed of 2 tees and an appropriate U-bend with the open end of each tee plugged. Pipe cap or plug cleanouts shall be provided where indicated. Drains indicated to connect to the sanitary waste system shall be connected by an indirect waste fitting. Air conditioner drain lines shall be insulated as specified in Section 15250 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.1.6 Pipe-Alignment Guides

Pipe-alignment guides shall be provided where indicated for expansion loops, offsets, and bends and as recommended by the manufacturer for expansion joints, not to exceed 5 feet on each side of each expansion joint, and in lines 4 inches or smaller not more than 2 feet on each side of the joint.

3.1.7 Omitted

3.1.8 Omitted

3.1.9 Equipment and Installation

Frames and supports shall be provided for tanks, compressors, pumps, valves, air handling units, fans, coils, dampers, and other similar items requiring supports. Air handling units shall be anchored to existing pad or finished floor by lagging bolts. Bolt size shall match mounting holes in unit.

3.1.10 Omitted

3.1.11 Flexible Connectors

Pre-insulated flexible connectors and flexible duct shall be attached to other components in accordance with the latest printed instructions of the manufacturer to ensure a vapor tight joint. Hangers, when required to suspend the connectors, shall be of the type recommended by the connector or duct manufacturer and shall be provided at the intervals recommended.

3.1.12 Sleeved and Framed Openings

Space between the sleeved or framed opening and the duct or the duct insulation shall be packed as specified in Section 07270 FIRESTOPPING for fire rated penetrations. For non-fire rated penetrations, the space shall be packed as specified in Section 07920 JOINT SEALING.

3.1.13 Metal Ductwork

Installation shall be according to SMACNA-06 unless otherwise indicated. Duct supports for sheet metal ductwork shall be according to SMACNA-06, unless otherwise specified. Friction beam clamps indicated in SMACNA-06 shall not be used.

3.1.14 Dust Control

To prevent the accumulation of dust, debris and foreign material during construction, temporary dust control protection shall be provided. The distribution system (supply and return) shall be protected with temporary seal-offs at all inlets and outlets at the end of each day's work. Temporary protection shall remain in place until system is ready for startup.

3.1.15 Insulation

Thickness and application of insulation materials for ductwork, piping, and equipment shall be according to Section 15250 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.2 FIELD PAINTING AND PIPING IDENTIFICATION

Finish painting of items only primed at the factory or surfaces not specifically noted otherwise shall be two coats of exterior oil paint.

3.3 PIPING HYDROSTATIC TEST

After cleaning, water piping shall be hydrostatically tested at a pressure equal to 150 percent of the total system operating pressure for period of time sufficient to inspect every joint in the system and in no case less than 2 hours. Leaks shall be repaired and piping retested until test is successful. No loss of pressure will be allowed. Leaks shall be repaired by re-welding or replacing pipe or fittings. Caulking of joints will not be permitted. Concealed and insulated piping shall be tested in place before covering or concealing.

3.4 CLEANING AND ADJUSTING

Pipes shall be cleaned free of scale and thoroughly flushed of foreign matter. A temporary bypass shall be provided for water coils to prevent flushing water from passing through coils. Strainers and valves shall be thoroughly cleaned. Prior to testing and balancing, air shall be removed from water systems by operating the air vents. Temporary measures, such as piping the overflow from vents to a collecting vessel shall be taken to avoid water damage during the venting process. Air vents shall be plugged or capped after the system has been vented. Inside of ducts, plenums, and casing shall be thoroughly cleaned of debris and blown free of small particles of rubbish and dust and then shall be vacuum cleaned before installing outlet faces. Equipment shall be wiped clean, with traces of oil, dust, dirt, or paint spots removed. System shall be maintained in clean condition until final acceptance. Bearings shall be properly lubricated with oil or grease as recommended by the manufacturer. Belts shall be tightened to proper tension. Control valves and other miscellaneous equipment requiring adjustment shall be adjusted to setting indicated or directed. Fans shall be adjusted to the speed indicated by the manufacturer to meet specified conditions.

3.5 TESTING, ADJUSTING, AND BALANCING

Testing, adjusting, and balancing shall be as specified in Section 15990 TESTING, ADJUSTING AND BALANCING OF HVAC SYSTEMS. Testing, adjusting, and balancing shall begin only when the air supply and distribution, including controls, has been completed, with the exception of performance tests.

3.6 PERFORMANCE TESTS

After testing, adjusting, and balancing has been completed as specified, each system shall be tested as a whole to see that all items perform as integral parts of the system. Corrections and adjustments shall be made as necessary to produce the conditions indicated or specified. Capacity tests and general operating tests shall be conducted by an experienced engineer. Tests shall demonstrate that the entire system is functioning according to the specifications.

(END OF SECTION)

SECTION 15950**HEATING, VENTILATING AND AIR CONDITIONING (HVAC) CONTROL SYSTEMS****PART 1 GENERAL****1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

AMCA 500 (1989) Test Methods for Louvers, Dampers and Shutters

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 269 (1994a) Seamless and Welded Austenitic Stainless Steel Tubing for General Service

ASTM B 88 (1996) Seamless Copper Water Tube

ASTM D 635 (1991) Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position

ASTM D 1693 (1994) Environmental Stress-Cracking of Ethylene Plastics

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B40.1 (1991) Gauges - Pressure Indicating Dial Type - Elastic Element

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41 (1991) Surge Voltages in Low-Voltage AC Power Circuits

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (1991) Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A (1993) Installation of Air Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES (UL)

UL 94 (1996) Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

UL 268A (1993; Rev Apr 1994) Smoke Detectors for Duct Application

UL 508 (1993) Industrial Control Equipment

1.2 GENERAL REQUIREMENTS

1.2.1 Verification of Dimensions

The Contractor shall become familiar with all details of the work, shall verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work.

1.2.2 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. The Contractor shall investigate the mechanical, electrical, and finish conditions that could affect the work to be performed, shall arrange such work accordingly, and shall furnish all work necessary to meet such conditions.

1.3 SUBMITTALS

The following shall be submitted for Government approval:

1.3.1 Drawings

1.3.1.1 HVAC Control System;

Drawings on A1 34 by 22 inch sheets in the form and arrangement shown. The drawings shall use the same abbreviations, symbols, nomenclature and device identifiers shown. Each control-system element on a drawing shall have a unique identifier as shown. All HVAC control system drawings shall be delivered together as a complete submittal. Drawings shall be submitted for each HVAC system.

- a. HVAC control system drawings shall include the following:

Sheet One: Drawing index, HVAC control system legend.

Sheet Two: Valve schedule, damper schedule.

Sheet Three: Omitted.

Sheet Four: HVAC control system schematic and equipment schedule.

Sheet Five: HVAC control system sequence of operation and ladder diagram.

Sheet Six: HVAC control panel arrangement, control panel cross-section, and control panel inner door layout.

Sheet Seven: HVAC control panel back-panel layout.

Sheet Eight: Control loop wiring diagrams.

Sheet Nine: Motor starter and relay wiring diagram.

Note: Repeat sheets four through nine for each AHU system.

- b. An HVAC control system drawing index showing the name and number of the building, military site, State or other similar designation, and Country. The drawing index shall list all HVAC control system drawings, including the drawing number, sheet number, drawing title, and computer filename when used.

- c. An HVAC control system legend showing generic symbols and the name of devices shown on the HVAC control system drawings.

d. Omitted.

e. A damper schedule showing each damper and actuator's identifier, nominal and actual sizes, orientation of axis and frame, direction of blade rotation, spring ranges, operation rate, positive positioner ranges, locations of actuators and damper end switches, arrangement of sections in multi-section dampers, and methods of connecting dampers, actuators, and linkages. The damper schedule shall include the maximum leakage rate at the operating static-pressure differential. The damper schedule shall contain actuator selection data supported by calculations of the torque required to move and seal the dampers, access and clearance requirements.

f. Omitted.

g. An HVAC control system equipment schedule showing the control loop, device unique identifier, device function, setpoint, input range, and additional important parameters (i.e. output range).

h. An HVAC control system sequence of operation.

i. An HVAC control system ladder diagram showing all relays, contacts, pilot lights, switches, fuses and starters connected to the control system.

j. HVAC control panel arrangement drawings showing both side and front views of the panel. The drawing shall show panel and mounting dimensions.

k. HVAC control panel cross-section drawings showing mounting rails and standoffs for devices.

l. HVAC control panel inner door layout drawings showing both front and rear views of the inner door. The drawings shall show device locations, labels, nameplate legends, and fabrication details.

m. HVAC control panel back-panel layout drawings showing device locations, labels, nameplate legends, terminal block layout, fabrication details, and enclosure operating temperature-rise calculations.

n. HVAC control system wiring diagrams showing functional wiring diagrams of the interconnection of conductors and cables to HVAC control panel terminal blocks and to the identified terminals of devices, starters and package equipment. The wiring diagrams shall show all necessary jumpers and ground connections. The wiring diagrams shall show the labels of all conductors. Sources of power required for HVAC control systems and for packaged-equipment control systems shall be identified back to the panel-board circuit breaker number, HVAC system control panel, magnetic starter, or packaged equipment control circuit. Each power supply and transformer not integral to a controller, starter, or packaged equipment shall be shown. The connected volt-ampere load and the power supply volt-ampere rating shall be shown.

1.3.2 Statements

1.3.2.1 Performance Verification Test Procedures;

Six copies of the HVAC control system performance verification test procedures, in indexed booklet form, 60 days before the Contractor's scheduled test dates. The performance verification test procedures shall refer to the devices by their unique identifiers as shown, shall explain, step-by-step, the actions and expected results that will demonstrate that the HVAC control system performs in accordance with the sequences of operation. An HVAC control system performance verification test equipment list shall be included that lists the equipment to be used during performance verification testing. The list shall include manufacturer name, model number, equipment function, the date of the latest calibration, and the results of the latest calibration.

1.3.3 Reports

1.3.3.1 Performance Verification Test Report;

Six copies of the HVAC control system performance verification test report, in indexed booklet form, within 30 days after completion of the test. The HVAC control system performance verification test report shall include data collected during the HVAC control system performance verification test. The original copies of data gathered during the performance verification test shall be turned over to the Government after Government approval of the test results.

1.3.4 Operation and Maintenance Manuals

1.3.4.1 Operation Manual;

1.3.4.2 Maintenance and Repair Manual;

Six copies of the HVAC control system operation manual and HVAC control system maintenance and repair manual for each HVAC control system 30 days before the date scheduled for the training course.

1.4 DELIVERY AND STORAGE

Products shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, and other contaminants, within the storage-condition limits published by the equipment manufacturer. Dampers shall be stored so that seal integrity, blade alignment and frame alignment are maintained.

1.5 OPERATION MANUAL

An HVAC control system operation manual for each HVAC control system, in indexed booklet form, shall be provided. The operation manual shall include the HVAC control system sequence of operation, and procedures for the HVAC system start-up, operation and shut-down. The operation manual shall include as-built HVAC control system detail drawings. The operation manual shall include the as-built controller configuration checksheets, the as-built time clock configuration checksheet, the HVAC control system front panel description, the procedures for changing HVAC system controller setpoints, the procedures for gaining manual control of processes, the time clock manufacturer's manual control of processes, the time clock manufacturer's operation manual, and the controller manufacturer's operation manual.

a. The HVAC control system front panel description shall explain the meaning and use of the lights, switches, gauges, and controller displays located in the front panel. Each light, switch, gauge, and display described shall be numbered and referenced to a drawing of the front panel.

b. The procedures for changing HVAC system controller setpoints shall describe the step-by-step procedures required to change: the process variable setpoints of controllers, the alarm setpoints of controllers, the controller bias settings, and controller setpoint reset schedules.

c. The procedures for gaining manual control of processes shall describe step-by-step procedures required to gain manual control of devices and manually adjust their positions.

1.6 MAINTENANCE AND REPAIR MANUAL

An HVAC control system maintenance and repair manual for each HVAC control system, in indexed booklet form in hardback binders, shall be provided. The maintenance and repair manual shall include the routine maintenance checklist, a recommended repair methods list, a list of recommended maintenance and repair tools, the qualified service organization list, the as-built commissioning procedures and report, the as-built performance verification test procedures and report, and the as-built equipment data booklet (EDB).

a. The routine maintenance checklist shall be arranged in a columnar format. The first column shall list all devices listed in the equipment compliance booklet (ECB), the second column shall state the maintenance activity or state no maintenance required, the third column shall state the frequency of the maintenance activity, and the fourth column for additional comments or reference.

b. The recommended repair methods list shall be arranged in a columnar format and shall list all devices in the equipment compliance booklet (ECB) and state the guidance on recommended repair methods, either field repair, factory repair, or whole-item replacement.

c. The as-built equipment data booklet (EDB) shall include the equipment compliance booklet (ECB) and all manufacturer supplied user manuals and information.

d. If the operation manual and the maintenance and repair manual are provided in a common volume, they shall be clearly differentiated and separately indexed.

PART 2 PRODUCTS

2.1 MATERIAL AND EQUIPMENT

Material and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of such products which are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The 2 years experience must be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. The equipment items shall be supported by a service organization. The Contractor shall submit a certified list of qualified permanent service organizations and qualifications. These service organizations shall be reasonably convenient to the equipment on a regular and emergency basis during the warranty period.

2.2 GENERAL EQUIPMENT REQUIREMENTS

2.2.1 Electrical and Electronic Devices

All electrical, electronic, and electro-pneumatic devices not located within an HVAC control panel shall have a NEMA Type 1 enclosure in accordance with NEMA 250 unless otherwise shown.

2.2.2 Standard Signals

The output of all analog transmitters and the analog input and output of all single-loop controllers and function modules shall be 4-to-20 mA_{dc} signals. The signal shall originate from current-sourcing devices and shall be received by current-sinking devices.

2.2.3 Ambient Temperature Limits

Ambient Temperature Actuators and positive positioners, and transmitters shall operate within temperature limit ratings of 40 to 140 degrees F. All panel-mounted instruments shall operate within limit ratings of 35 to 120 degrees F and 10 percent to 95 percent relative humidity, noncondensing. All devices installed outdoors shall operate within limit ratings of minus minus 40 to plus 150 degrees F.

2.2.4 Nameplates, Lens Caps, and Tag Nameplates

Nameplates, lens caps, and lens caps bearing legends as shown and tags bearing device-unique identifiers as shown shall have engraved or stamped characters. A plastic or metal tag shall be mechanically attached directly to each device or attached by a metal chain or wire. Each air flow measurement station shall have a tag showing flow rate range for signal output range, duct size, and identifier as shown.

2.3 MATERIALS

2.3.1 Tubing

2.3.1.1 Copper

Copper tubing shall conform to ASTM B 88 and shall have sweat fittings and valves.

2.3.1.2 Plastic

Plastic tubing shall have barbed fittings and valves. Plastic tubing shall have the burning characteristics of linear low-density polyethylene tubing, shall be self-extinguishing when tested in accordance with ASTM D 635, shall have UL 94 V-2 flammability classification, and shall withstand stress cracking when tested in accordance with ASTM D 1693. Plastic-tubing bundles shall be provided with Mylar barrier and flame-retardant polyethylene jacket.

2.3.1.3 Stainless Steel

Stainless steel tubing shall conform to ASTM A 269, and shall have stainless steel compression fittings.

2.3.2 Wiring

2.3.2.1 Terminal Blocks

Terminal blocks shall be insulated, modular, feed-through, clamp style with recessed captive screw-type clamping mechanism, shall be suitable for rail mounting, and shall have end plates and partition plates for separation or shall have enclosed sides.

2.3.2.2 Control Wiring for 24-Volt Circuits

Control wiring for 24-volt circuits shall be 18 AWG minimum, stranded copper and shall be rated for 300-volt service.

2.3.2.3 Wiring for 120-Volt Circuits

Wiring for 120-volt circuits shall be 18 AWG minimum, stranded copper and shall be rated for 600-volt service.

2.3.2.4 Analog Signal Wiring Circuits

Analog signal wiring circuits within control panels shall not be less than 20 AWG and shall be rated for 300-volt service.

2.3.2.5 Instrumentation Cable

Instrumentation cable shall be 18 AWG, stranded copper, single or multiple-twisted, minimum 2 inch lay of twist, 100 percent shielded pairs, and shall have a 300-volt insulation. Each pair shall have a 20 AWG tinned-copper drain wire and individual overall pair insulation. Cables shall have an overall aluminum-polyester or tinned-copper cable-shield tape, overall 20 AWG tinned-copper cable drain wire, and overall cable insulation.

2.3.2.6 Nonconducting Wiring Duct

Nonconducting wiring duct in control panels shall have wiring duct in control panels shall have slotted sides, snap-on duct covers, have slotted sides, snap-on duct covers, fittings for connecting ducts, mounting clips for securing ducts, and wire-retaining clips.

2.3.2.7 Transformers

Step-down transformers shall be utilized where control equipment operates at lower than line circuit voltage. Transformers, other than transformers in bridge circuits, shall have primaries wound for the voltage available and secondaries wound for the correct control circuit voltage. Transformers shall be sized so that the connected load is 80 percent of the rated capacity or less. Transformers shall conform to UL 508.

2.4 ACTUATORS

Actuators shall be, electric or electronic as shown and shall be provided with mounting and connecting hardware. Actuators shall fail to their spring-return positions on signal or power failure. The actuator stroke shall be limited in the direction of power stroke by an adjustable stop. Actuators shall have a visible position indicator. Actuators shall smoothly open or close the devices to which they are applied and shall have a full stroke response time of 60 seconds or less. Electric or electronic actuators operating in series shall have an auxiliary actuator driver. Electric actuators shall have an oil-immersed gear train. Electric actuators used in a sequencing application shall have zero and span adjustments.

2.4.1 Omitted.

2.5 Omitted.

2.6 DAMPERS

2.6.1 Damper Assembly

A single damper section shall have blades no longer than 48 inches and shall be no higher than 72 inches. Maximum damper blade width shall be 8 inches. Larger sizes shall be made from a combination of sections. Dampers shall be steel, or other materials where shown. Flat blades shall be made rigid by folding the edges. All blade-operating linkages shall be within the frame so that blade-connecting devices within the same damper section will not be located directly in the air stream. Damper axles shall be 0.5 inch minimum plated steel rods supported in the damper frame by stainless steel or bronze bearings. Blades mounted vertically shall be supported by thrust bearings. Pressure drop through dampers shall not exceed 0.04 inch water gauge at 1,000 fpm in the wide-open position. Frames shall not be less than 2 inches in width. Dampers shall be tested in accordance with AMCA 500.

2.6.1.1 Operating Links

Operating links external to dampers (such as crankarms, connecting rods, and line shafting for transmitting motion from damper actuators to dampers) shall withstand a load equal to at least twice the maximum required damper-operating force. Rod lengths shall be adjustable. Links shall be brass, bronze, zinc-coated steel, or stainless steel. Working parts of joints and clevises shall be brass, bronze, or stainless steel. Adjustments of crankarms shall control the open and closed positions of dampers.

2.6.1.2 Damper Types

Dampers shall be parallel blade type.

2.6.2 Outside-Air, Return-Air, and Relief-Air Dampers

The dampers shall be provided where shown. Blades shall have interlocking edges and shall be provided with compressible seals at points of contact. The channel frames of the dampers shall be provided with jamb seals to minimize air leakage. Dampers shall not leak in excess of 20 cfm per square foot at 4 inches water gauge static pressure when closed. Seals shall be suitable for an operating temperature range of minus 40 to plus 200 degrees F. Dampers shall be rated at not less than 2000 fpm air velocity.

2.6.3 Omitted

2.6.4 Omitted

2.6.5 Omitted

2.7 DUCT SMOKE DETECTORS

Duct smoke detectors shall conform to the requirements of UL 268A. Duct smoke detectors shall have perforated sampling tubes extended into the air duct. Detector circuitry shall be mounted in a metallic enclosure exterior to the duct. Detectors shall have manual reset. Detectors shall be powered from the HVAC control panel. Detectors shall have two sets of normally open alarm contacts and two sets of normally closed alarm contacts. Detectors shall be connected to the building fire alarm panel for alarm initiation. A remote annunciation lamp and accessible remote reset switch shall be provided for duct detectors that are mounted eight feet or more above the finished floor and for detectors that are not readily visible. Remote lamps and switches as well as each affected fan unit shall be properly identified in etched rigid plastic placards.

2.8 INSTRUMENTATION

2.8.1 Measurements

Transmitters shall be factory calibrated to provide an output of 4 to 20 mAdc over the indicated ranges:

- a. Conditioned space temperature, from 50 to 85 degrees F.
- b. Duct temperature, from 40 to 140 degrees F except that return-air temperature for economizer operation shall be minus 30 to plus 130 degrees F.
- c. Omitted.
- d. Relative humidity, 0 to 100 percent for space and duct high-limit applications.

2.8.2 Temperature Instruments

2.8.2.1 Resistance Temperature Detectors (RTD)

Temperature sensors shall be 100 ohms 3- or 4-wire RTD. Each RTD shall be platinum with a tolerance of plus or minus 0.1 percent at 32 degrees F, and shall be encapsulated in epoxy, series 300 stainless steel, anodized aluminum, or copper. Each RTD shall be furnished with an RTD transmitter as specified, integrally-mounted unless otherwise shown.

2.8.2.2 Continuous-Averaging RTD

Continuous-averaging RTDs shall have a tolerance of plus or minus 1.0 degree F at the reference temperature, and shall be of sufficient length to ensure that the resistance represents an average over the cross-section in which it is installed. The sensing element shall have a bendable copper sheath. Each averaging RTD shall be furnished with an RTD transmitter as specified, to match the resistance range of the averaging RTD.

2.8.2.3 RTD Transmitter

The RTD transmitter shall accept a 3-wire 100 ohm RTD input. The transmitter shall be a 2-wire, loop-powered device. The transmitter shall produce a linear 4-to-20 mAdc output corresponding to the required temperature measurement. The output error shall not exceed 0.1 percent of the calibrated span. The transmitter shall include offset and span adjustments.

2.8.3 Omitted.

2.8.4 Omitted.

2.8.5 Omitted.

2.8.6 Pressure Instruments

The instrument shall be a pressure transmitter with an integral sensing element. The instrument over pressure rating shall be 300 percent of the operating pressure. The sensor/transmitter assembly accuracy shall be plus or minus 2 percent of full scale. The transmitter shall be a 2-wire, loop-powered device. The transmitter shall produce a linear 4-to-20 mA_{dc} output corresponding to the required pressure measurement. Each transmitter shall have offset and span adjustments.

2.8.7 Thermowells

Thermowells shall be Series 300 stainless steel with threaded brass plug and chain, 2 inch lagging neck and extension-type well, and inside diameter and insertion length as required for the application.

2.8.8 Omitted

2.9 THERMOSTATS

Thermostat ranges shall be selected so that the setpoint is adjustable between plus or minus 10 degrees F of the setpoint shown. Thermostats shall be electronic or electric.

2.9.1 Omitted.

2.9.2 Omitted.

2.9.3 Omitted.

2.9.4 Nonmodulating Capillary Thermostats and Aquastats

Each thermostat shall have a capillary length of at least 5 feet, shall have adjustable direct-reading scales for both setpoint and differential, and shall have a differential adjustable from 6 to 16 degrees F. Aquastats shall be of the strap-on type, with 10 degrees F fixed differential.

2.9.5 Low-Temperature-Protection Thermostats

Low-temperature-protection thermostats shall be, low-temperature safety thermostats, with NO and NC contacts and manual reset, with an element length of 20 feet, which shall respond to the coldest 18 inch segment.

2.10 PRESSURE SWITCHES AND SOLENOID VALVES

2.10.1 Pressure Switches

Each switch shall have an adjustable setpoint with visible setpoint scale. Range shall be as shown. Differential adjustment shall span 20 to 40 percent of the range of the device.

2.10.2 Differential-Pressure Switches

Each switch shall be an adjustable diaphragm-operated device with two SPDT contacts, with taps for sensing lines to be connected to duct pressure fittings designed to sense air pressure. These fittings shall be of the angled-tip type with tips pointing into the air stream. The setpoint shall not be in the upper or lower quarters of the range and the range shall not be more than three times the setpoint. Differential shall be a maximum of 0.15 inch water gauge at the low end of the range and 0.35 inch water gauge at the high end of the range.

2.10.3 Omitted.

2.10.4 Omitted.

2.11 INDICATING DEVICES

2.11.1 Thermometers

2.11.1.1 Piping System Thermometers

Piping system thermometers shall have brass, malleable iron or aluminum alloy case and frame, clear protective face, permanently stabilized glass tube with indicating-fluid column, white face, black numbers, and a 9 inch scale. Thermometers for piping systems shall have rigid stems with straight, angular, or inclined pattern.

2.11.1.2 Piping System Thermometer Stems

Thermometer stems shall have expansion heads as required to prevent breakage at extreme temperatures. On rigid-stem thermometers, the space between bulb and stem shall be filled with a heat-transfer medium.

2.11.1.3 Non-Averaging Air-Duct Thermometers

Air-duct thermometers shall have perforated stem guards and 45-degree adjustable duct flanges with locking mechanism.

2.11.1.4 Averaging Air-Duct Thermometers

Averaging thermometers shall have a 3-1/2 inch nominal dial, with black legend on white background, and pointer traveling through a 270-degree arc.

2.11.1.5 Accuracy

Thermometers shall have an accuracy of plus or minus 1 percent of scale range. Thermometers shall have a range suitable for the application.

2.11.2 Pressure Gauges

Gauges shall be 2 inch nominal size, back connected, suitable for field or panel mounting as required, shall have black legend on white background, and shall have a pointer traveling through a 270-degree arc. Accuracy shall be plus or minus 3 percent of scale range. Gauges shall meet requirements of ASME B40.1.

2.11.2.1 Omitted.

2.11.2.2 Omitted.

2.11.2.3 Omitted.

2.11.2.4 Control Panel Pressure Gauges

Panel mounted air pressure gauges shall have a scale of 0 to 30 psig with 1 psig graduations.

2.11.3 Low Differential Pressure Gauges

Gauges for low differential-pressure measurements shall be a minimum of 3.5 inch (nominal) size with two sets of pressure taps, and shall have a diaphragm-actuated pointer, white dial with black figures, and pointer zero adjustment. Gauges shall have ranges and graduations as shown. Accuracy shall be plus or minus 2 percent of scale range.

2.12 SINGLE-LOOP CONTROLLERS

2.12.1 Controller Features

The controller shall be a microprocessor-based single-loop device that does not require Contractor generated software. The controller shall be mountable in a panel cutout measuring 3.62 by 3.62 inches. The controller shall have field scalable process variable, a remote setpoint analog input and an analog output with adjustable high and low end limits and proportional control manual reset adjustment. The analog output shall result from proportional, integral and derivative (PID) control. The analog output shall be configurable as direct acting and reverse acting. The controller shall have keyboard, display, auto/manual selection for control of its analog output, remote setpoint adjustment/local setpoint adjustment selection with adjustable high-end and low-end limits, ratio and bias adjustments on remote setpoint input, operator-initiated self-tune/manual-tune selection, anti-reset wind-up feature, and 2 independent SPDT contact-closure outputs (PV alarm and deviation alarm). The controller shall be configurable to power-up in automatic with local setpoint control and in automatic with remote setpoint control. The range of hysteresis adjustment shall be not smaller than from 1 percent to 5 percent of process variable input span. The controller shall power the analog output loop to 20 milliamperes when connected to a load of 600 ohms. The controller shall be capable of retransmitting the process variable to 20 milliamperes when connected to 600 ohms. The controller shall have 5-year battery backup to store operating parameters or shall have nonvolatile memory.

2.12.2 Parameter Input and Display

Control parameters shall be entered and displayed directly, in the correct engineering units, through a series of keystrokes on a front-panel display with a 3-1/2 digit, 7-segment display, with decimal point and polarity indication. The use of this display shall allow manual interrogation of setpoint, mode constants, and values of the process variable and output.

2.12.3 Controller Electrical Requirements

Each controller shall be powered by 120 volts ac. Power consumption shall not be greater than 25 watts. Each controller shall provide electrical noise isolation between the ac power line and the process variable input, remote setpoint input, and output signals and of not less than 100 db at 60 Hz common-mode rejection ratio, and not less than 60 db at 60 Hz normal-mode rejection ratio.

2.12.4 Controller Accuracy

The controller shall have an accuracy of plus or minus 0.30 percent of input span, plus or minus 1 digit.

2.12.5 Self-Tuning

The controller self-tuning operation shall apply proportional, integral, and derivative modes of control and shall modify the mode constants as required. Self-tuning shall only be in operation when selected from the front panel.

2.12.6 Manual-Tuning

The controller manual-tuning operation shall provide proportional, integral, and derivative control modes, or any combination thereof, by means of individual mode constant adjustments. These adjustments shall be set for the appropriate value if a particular control mode action is desired, or to zero if that particular mode is not desired. The proportional-mode constant shall be adjustable from 0 to 200 percent of input signal range, the integral-mode constant shall be adjustable from 0 to 20 repeats per minute, and derivative-mode constant shall be adjustable from 0 to 5 minutes.

2.13 CONTROL DEVICES AND ACCESSORIES

Control device and accessory input impedance shall not exceed 250 ohms.

2.13.1 Function Modules

Function modules shall accept mAdc analog input signals to produce mAdc analog output signals or contact output signals. Modules shall have zero and span adjustments for analog outputs, and setpoint adjustments for contact outputs. Module output span accuracy shall be plus or minus 1 percent of input span. Modules shall be rail-mounted as shown. Power consumption shall be not greater than 5 watts.

2.13.1.1 Minimum-Position Switch and Temperature-Setpoint Device

Minimum-position switch and temperature-setpoint device shall accept a 1000 ohms potentiometer input and shall produce a steady analog output. In temperature setpoint applications the potentiometer shall be single-turn, suitable for wall mounting, enclosed in a locking metal or heavy duty plastic enclosure and shall have a graduated dial corresponding to the range of the setpoint adjustment. In a minimum position switch application the potentiometer shall be mounted on or internal to the minimum position switch. The device shall have its input signal electrically or optically isolated from output. Mounting socket shall be an 8 pin base with pins 1, 2, 3 ac power input, 4, 5, 6 input signal, 7, 8, output signal.

2.13.1.2 Signal-Inverter Modules

Signal inverter shall accept an analog input signal and shall have sufficient output capacity to drive the output signal through a circuit with an impedance of not less than 600 ohms. The output shall be electrically isolated from the input and the device shall have a moisture resistant coating. Mounting socket shall be an 8 pin base with pins 1, 2, 3 ac power input, 4, 5, 6 input signal, 7, 8, output signal.

2.13.1.3 High-Low Signal Selector

High-low signal-selector modules shall accept analog input signals and select either the highest or the lowest input signal as the output signal. The signal selector shall be powered by 120 Vac and the output signal shall be electrically isolated from the input signal.

2.13.1.4 Omitted.

2.13.1.5 Omitted.

2.13.2 Relays

Relays shall be 2-pole, double-throw (2PDT) with a 10-ampere resistive rating at 120 Vac, and shall have an enclosed 120-Vac coil with 8 pin blade connectors, and a matching rail-mounted socket. Power consumption shall not be greater than 3 watts.

2.13.3 Time-Delay Relays

Time delay relays shall be 2PDT with 8 pin connectors, dust cover, and a matching rail-mounted socket. Adjustable timing range shall be 0 to 5 minutes. Power consumption shall be not greater than 3 watts.

2.13.4 Time Clocks

Each time clock shall be a 365-day programmable timing device with 4 independently timed circuits. Each clock shall have a manual scheduling keypad and an alphanumeric display of all timing parameters. Timing parameters shall include: date in Gregorian calendar for month, day and day-of-month indication; and 24-hour time-of-day display, with one-minute resolution for programming the ON and OFF times for each circuit. Each clock shall allow programming of each circuit for 12 holiday periods for either ON or OFF events for any selected duration of the 365-day program. Each clock shall have capacity for programming 4 ON events and 4 OFF events per day for each

circuit. The programmed events shall be assignable to a 365-day schedule. Each clock shall have automatic Standard Time and Daylight Saving Time adjustment, by input of the appropriate dates. Each time clock shall have automatic leap year correction. Each clock shall be provided with 4-day battery backup. Power consumption shall not be greater than 10 watts.

2.13.5 Current-to-Pneumatic (IP) Transducers

The transducers shall be 2-wire current-to-pressure transmitters that convert a 4-to-20 mA_{dc} input signal to a 3 to 15 psig, or a 15 to 3 psig, pneumatic output, with a conversion accuracy of plus or minus 2 percent of full scale, including linearity and hysteresis. Input impedance shall not exceed 250 ohms. Air consumption shall not be greater than 0.25 scfm.

2.13.6 Direct Current (DC) Power Supply

One DC power supply shall be used to power all transmitters connected to the control panel. The power supply shall be 24 V_{dc} at not less than 1.2 amperes, with a peak-to-peak ripple not to exceed 0.03 percent of output voltage. Each power supply shall have a fused input, and shall be protected from voltage surges and powerline transients. The power supply output shall be protected against overvoltage and short circuits.

2.13.7 Power Line Conditioner (PLC)

PLCs shall be furnished for each controller panel. The PLCs shall provide both voltage regulation and noise rejection. The PLCs shall be of the ferro-resonant design, with no moving parts and no tap switching, while electrically isolating the secondary from the power line side. The PLCs shall be sized for 125 percent of the actual connected kva load. Characteristics of the PLC shall be as follows:

- a. At 85 percent load, the output voltage shall not deviate by more than plus or minus 1 percent of nominal voltage when the input voltage fluctuates between minus 20 percent to plus 10 percent of nominal voltage.
- b. During load changes of zero to full load, the output voltage shall not deviate by more than plus or minus 3 percent of nominal voltage. Full correction of load switching disturbances shall be accomplished within 5 cycles, and 95 percent correction shall be accomplished within 2 cycles of the onset of the disturbance.
- c. Total harmonic distortion shall not exceed 3-1/2 percent at full load.

2.14 PILOT LIGHTS AND MANUAL SWITCHES

Pilot lights and switches shall be rectangular devices arranged in a horizontal matrix as shown. Momentary switches shall be non-illuminated. Interlocking switches shall have separately illuminated sections. Split legend lights shall have separately illuminated sections. Device illumination shall be by light-emitting diode or neon lamp.

2.15 HVAC SYSTEM CONTROL PANELS

2.15.1 Panel Assembly

The control panel shall be factory assembled and shipped to the job site as a single unit. The panel shall be fabricated as shown, and the devices shall be mounted as shown. Each panel shall be fabricated as a bottom-entry connection point for control-system electric power, control-system main air source, control-system wiring, pneumatic tubing, interconnection of control systems, interconnection of starters and external shutdown devices, and energy monitoring and control systems (EMCS) interface. Each panel shall have an operating temperature rise of not greater than 20 degrees F above an ambient temperature of 100 degrees F.

2.15.2 Panel Electrical Requirements

Each control panel shall be powered by nominal 120 volts ac, fused at 5 amps, terminating at the panel on terminal blocks. Instrument cases shall be grounded. Interior panel, interior door, and exterior panel enclosure shall be grounded.

2.15.3 Enclosure

The enclosure for each panel shall be a NEMA 12 single-door wall-mounted box conforming to NEMA 250, with continuous hinged and gasketed exterior door with print pocket and key lock, continuous hinged interior door, interior back panel, and ventilation louvers in back surface as shown. Inside finish shall be white enamel, and outside finish shall be gray primer over phosphatized surfaces.

2.15.4 Mounting and Labeling

Controllers, pilot lights, switches, IP's, and pressure gauge shall be mounted on the interior door as shown. Power conditioner, fuses and duplex outlet shall be mounted on the interior of the cabinet as shown. All other components housed in the panel shall be mounted on the interior back panel surface of the enclosure, behind the door on rails as shown. Controllers and gauges mounted on the front of the inner door shall be identified by a plastic or metal nameplate as shown that is mechanically attached to the panel. Function modules, relays, timeclocks, IP transducers, DC power supply, and other devices interior to the panel shall be identified by a plastic or metal nameplate that is mechanically attached to the panel. The nameplate shall have the inscription as shown. Lettering shall be cut or stamped into the nameplate to a depth of not less than 1/64 inch, and shall show a contrasting color, produced by filling with enamel or lacquer or by the use of a laminated material. Painting of lettering directly on the surface of the interior door or panel is not permitted.

2.15.5 Wiring and Tubing

2.15.5.1 Current-to-Pneumatic Transducers (IP)

Current-to-pneumatic transducers (IP) shall be piped to bulkhead fittings in the bottom of the panel with a 2 inch loop to accommodate IP replacement and shall be wired to identified terminal blocks.

2.15.5.2 Panel Wiring

Interconnections Wiring shall be installed in wiring ducts in such a way that devices can be added or replaced without disturbing wiring that is not affected by the change. Wiring to all devices shall have a 4 inch wiring loop in the horizontal wiring duct at each wiring connection. There shall be no wiring splices within the control panel. All interconnections required for power or signals shall be made on device terminals or panel terminal blocks, with not more than two wires connected to a terminal.

2.15.5.3 Panel Terminal Blocks

Terminal blocks shall be arranged in groups as shown. Instrument signal grounds at the same ground reference level shall end at a grounding terminal for connection to a common ground point. Wiring-shield grounds at the same reference level shall end at a grounding terminal for connection to a common ground point. Grounding terminal blocks shall be identified by reference level.

2.15.5.4 Wiring Identification

All wiring connected to controllers, time clocks and function modules shall be identified by function and polarity with full word identifiers, i.e., process variable input, remote setpoint input and control output.

2.15.6 EMCS Terminal Blocks

Terminal blocks shall be provided for connections to EMCS as shown. Analog signals shall require only the removal of jumpers to interface to EMCS.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION CRITERIA

The HVAC control system shall be installed and ready for operation, as specified and shown. Dielectric isolation shall be provided where dissimilar metals are used for connection and support. Penetrations through and mounting holes in the building exterior shall be made watertight. The HVAC control system installation shall provide clearance for control system maintenance by maintaining access space between coils, access space to mixed-air plenums, and other access space required to calibrate, remove, repair, or replace control system devices. The control system installation shall not interfere with the clearance requirements for mechanical installation shall not interfere with the clearance requirements for mechanical and electrical system maintenance.

3.1.1 Device Mounting Criteria

Devices mounted in or on piping or ductwork, on building surfaces, in mechanical/electrical spaces, or in occupied space ceilings shall be installed in accordance with manufacturer's recommendations and as shown. Control devices to be installed in piping and ductwork shall be provided with all required gaskets, flanges, thermal compounds, insulation, piping, fittings, and manual valves for shutoff, equalization, purging, and calibration. Strap-on temperature sensing elements shall not be used except as specified.

3.1.2 Wiring Criteria

Wiring external to control panels, including low-voltage wiring, shall be installed in metallic raceways. Wiring shall be installed without splices between control devices and HVAC control panels. Cables and conductors shall be tagged at both ends, with the identifier shown on the shop drawings, in accordance with the requirements of Section 16415 ELECTRICAL WORK, INTERIOR. Other electrical work shall be as specified in Section 16415 ELECTRICAL WORK, INTERIOR and as shown.

3.1.2.1 Power-Line Surge Protection

Equipment connected to ac circuits shall be protected from powerline surges. Equipment protection shall meet the requirements of IEEE C62.41. Fuses shall not be used for surge protection.

3.1.2.2 Surge Protection for Transmitter and Control Wiring

HVAC system control panel equipment shall be protected against surges induced on control and transmitter wiring installed outside and as shown. The equipment protection shall be tested in the normal mode and in the common mode, using the following two waveforms:

- a. A 10-microsecond by 1000-microsecond waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.
- b. An 8-microsecond by 20-microsecond waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.

3.1.2.3 Controller Output Loop Impedance Limitation

Controller output loops shall be constructed so that total circuit impedance connected to the analog output of a single-loop controller shall not exceed 600 ohms.

3.2 CONTROL SYSTEM INSTALLATION

3.2.1 Damper Actuators

Actuators shall not be mounted in the air stream. Multiple actuators operating a common damper shall be connected to a common drive shaft. Actuators shall be installed so that their action shall seal the damper to the extent required to maintain leakage at or below the specified rate and shall move the blades smoothly.

3.2.2 Local Gauges for Actuators

Pneumatic actuators shall have an accessible and visible receiver gauge installed in the tubing lines at the actuator as shown.

3.2.3 Room-Instrument Mounting

Room instruments shall be mounted so that their sensing elements are 5 feet above the finished floor unless otherwise shown. Temperature setpoint device shall be recess mounted.

3.2.4 Smoke Detectors

Duct smoke detectors shall be provided in supply and return air ducts in accordance with NFPA 90A.

3.2.5 Manual Emergency Fan Shutdown Switches

Manual emergency fan shutdown switches shall be provided for air distribution fans in accordance with NFPA 90A. Switches shall be the manual-reset type. Switches shall be located and mounted in an accessible manner, approximately 48 inches above the finished floor. Switches shall be properly identified in etched rigid plastic placards.

3.2.6 Low-Temperature-Protection Thermostats

For each 20 square feet of coil-face area, or fraction thereof, a thermostat shall be provided to sense the temperature at the location shown. The thermostat sensing element shall be installed in a serpentine pattern.

3.2.7 Averaging-Temperature Sensing Elements

Sensing elements shall have a total-element minimum length equal to 3.3 linear meter per square meter (one linear foot per square foot) of duct cross-sectional area.

3.2.8 Omitted.

3.2.9 Omitted.

3.2.10 Omitted.

3.2.11 Indication Devices Installed in Piping and Liquid Systems

Gauges in piping systems subject to pulsation shall have snubbers. Gauges for steam service shall have pigtail fittings with cock. Thermometers and temperature sensing elements installed in liquid systems shall be installed in thermowells.

3.2.12 Control System Tubing

The control system shall be installed so that pneumatic lines are not exposed to outside-air temperatures. Air lines shall be concealed except in mechanical rooms and other areas where other tubing and piping is exposed. All tubes and tube bundles exposed to view shall be installed neatly in lines parallel to the lines of the building. Tubing between panels and actuators in mechanical/electrical spaces shall be routed so that the lines are easily traceable. Air lines shall be tested periodically for leaks during installation. Air lines shall be purged of dirt, impurities and

moisture before connecting to the control equipment. Air lines shall be number coded or color coded and keyed to the submittal drawings for future identification and servicing the control system.

3.2.12.1 Pneumatic Lines In Mechanical/Electrical Spaces

In mechanical/electrical spaces, pneumatic lines shall be plastic tubing or copper tubing. Horizontal and vertical runs of plastic tubes or soft copper tubes shall be installed in raceways dedicated to tubing. The dedicated raceways shall be supported every 6 feet for horizontal runs and every 8 feet for vertical runs. Tubing not installed in raceways shall be hard-drawn copper tubing with sweat fittings and valves, supported every 6 feet for horizontal runs and every 8 feet for vertical runs.

3.2.12.2 Omitted.

3.2.12.3 Omitted.

3.2.12.4 Omitted.

3.2.12.5 Omitted.

3.2.12.6 Final Connection to Actuators

Final connections to actuators shall be plastic tubing 12 inches long and unsupported at the actuator.

3.2.12.7 Connection to HVAC Control Panel

A manual valve shall be provided at each HVAC control panel to allow shutoff of main air. Pneumatic connections to HVAC control panels shall be made at bulkhead fittings. Final connections to HVAC control panel bulkhead fitting shall be exposed tubing approximately 12 inches long.

3.3 CONTROL SEQUENCES OF OPERATION

3.3.1 System Requirements

These requirements shall apply to all primary HVAC systems unless modified herein. The sequences describe the actions of the control system for one direction of change in the HVAC process analog variable, such as temperature, humidity or pressure. The reverse sequence shall occur when the direction of change is reversed.

3.3.1.1 HVAC System Supply Fan Operating

HVAC system outside-air, return-air, and exhaust-air dampers shall function as described hereinafter for specific modes of operation. Interlocked exhaust fans shall be stopped in the unoccupied and ventilation delay modes and their dampers shall be closed. Interlocked exhaust fans shall run in the occupied mode, and their dampers shall open.

3.3.1.2 HVAC System Supply Fan Not Operating

When an HVAC system is stopped, interlocked fans shall stop, the outside-air and exhaust-air dampers shall close and the return-air damper shall open.

3.3.2 Single-Zone with Dual-Temperature Coil; No Return Fan

3.3.2.1 Occupied, Unoccupied, and Ventilation-Delay Modes

Ventilation-delay-mode timing shall start prior to the occupied-mode timing. The timeclock shall close a contact, which shall turn on the ventilation-delay pilot light and energize a relay which shall prevent the outside-air damper from opening. At the time shown, the timeclock shall close a contact which shall turn on the occupied-mode pilot

light and shall place the system in the occupied mode. At the expiration of the ventilation-delay-mode timing period, the timeclock shall open the contact to turn off the ventilation-delay-mode pilot light and de-energize a relay to allow the outside-air damper to open. At the time shown, the timeclock shall open the contact to turn off the occupied-mode pilot light and shall place the control system in the unoccupied mode of operation.

3.3.2.2 Outside-Air, Return-Air, and Exhaust-Air Dampers

- a. Occupied Mode - The outside-air, return-air, and exhaust-air dampers shall be in their energized positions.
- b. Unoccupied and Ventilation-Delay Modes - The dampers shall return to their normal positions as shown.

3.3.2.3 Supply-Fan Control

- a. Occupied and Ventilation-Delay Modes - Supply fan shall start, and shall operate continuously.
- b. Unoccupied Mode - The supply fan shall cycle from a night thermostat. The fan shall start at and stop at the setpoints as shown.

3.3.2.4 Filter

A differential-pressure switch across the filter shall turn on the filter pilot light when the pressure drop across the filter reaches the setpoint as shown.

3.3.2.5 Freeze Protection

All Modes - A freezestat, located as shown, shall stop the supply fan, cause the outside air, return air, and relief air dampers to return to their normal position as shown, and shall turn on the low-temperature pilot light in the HVAC control panel if the temperature drops below the freezestat's setpoint as shown. Return to the normal mode of operation shall require manual reset at the freezestat and at the HVAC control panel.

3.3.2.6 Omitted.

3.3.2.7 Omitted.

3.3.2.8 Omitted.

3.3.2.9 Space-Temperature-Sequenced Heating Control

The outside-air damper shall be open to the setting determined by the minimum-position switch. The space-temperature sensor and transmitter operating through the heating-season space-temperature controller shall maintain the setpoint as shown. On a rise in space temperature, the controller shall gradually divert airflow around the coil to maintain the setpoint as shown.

3.3.2.10 Space-Temperature Sequenced Cooling Control

The outside-air damper shall be open to the setting determined by the minimum-position switch. The space-temperature sensor and transmitter operating through the cooling-season space-temperature controller shall maintain the setpoint as shown. On a rise in space temperature, the controller shall gradually divert airflow through the coil to maintain the setpoint as shown.

3.3.2.11 Emergency Fan Shutdown

Activation of a duct smoke detector in the supply-air or return-air ductwork, or activation of a manual emergency fan shutdown switch shall cause the associated fan to shutdown in accordance with NFPA 90A. Activation of these

devices shall operate a pilot light on the HVAC control panel. The panel shall require manual resetting after the detector and the manual switch are reset.

3.3.2.12 Omitted.

3.3.2.13 Omitted.

3.4 COMMISSIONING PROCEDURES

3.4.1 General Procedures

3.4.1.1 Evaluations

The Contractor shall make the observations, adjustments, calibrations, measurements, and tests of the control systems, tune the controllers, set the timeclock schedule, and make any necessary control-system corrections to ensure that the systems function as described in paragraph CONTROL SEQUENCES OF OPERATION. The Contractor shall permanently record, on system equipment schedule, the final setting of controller proportional, integral and derivative constant settings, setpoint, manual reset setting, maximum and minimum controller output, and ratio and bias settings, in units and terminology specific to the controller.

3.4.1.2 Item Check

An item-by-item check of the sequence of operation requirement shall be performed using Steps 1 through 4 in the specified control system commissioning procedures. Steps 1, 2, and 3 shall be performed with the HVAC system shutdown; Step 4 shall be performed after the HVAC systems have been started. Signals used to change the mode of operation shall originate from the actual HVAC control device intended for the purpose, such as the time clock. External input signals to the HVAC control panel (such as EMCS, starter auxiliary contacts, and external systems) may be simulated in Steps 1, 2, and 3. With each operational-mode change signal, pilot lights and HVAC-panel output-relay contacts shall be observed to ensure that they function. All terminals assigned to EMCS shall be checked and observed to ensure that the proper signals are available.

3.4.1.3 Weather-Dependent Test Procedures

Weather-dependent test procedures that cannot be performed by simulation shall be performed in the appropriate climatic season. When simulation is used, the Contractor shall verify the actual results in the appropriate season.

3.4.1.4 Configuration

The Contractor shall configure each controller for its specified service.

3.4.1.5 Two-Point Accuracy Check

A two-point accuracy check of the calibration of each HVAC-control-system sensing element and transmitter shall be performed by comparing the HVAC-control-panel readout to the actual value of the variable measured at the sensing element and transmitter or airflow measurement station location. Digital indicating test instruments shall be used, such as digital thermometers, motor-driven psychrometers, and tachometers. The test instruments shall be at least twice as accurate as the specified sensing element-to-controller readout accuracy. The calibration of the test instruments shall be traceable to NIST standards. The first check point shall be with the HVAC system in the shutdown condition, and the second check point shall be with the HVAC system in an operational condition. Calibration checks shall verify that the sensing element-to-controller readout accuracies at two points are within the specified product accuracy tolerances. If not, the device shall be recalibrated or replaced and the calibration check repeated.

3.4.1.6 Insertion, Immersion Temperature

Insertion-temperature and immersion-temperature sensing element and transmitter-to-controller readout calibration accuracy shall be checked at one physical location along the axis of the sensing element.

3.4.1.7 Averaging Temperature

Averaging-temperature sensing element and transmitter-to-controller readout calibration accuracy shall be checked every 2 feet along the axis of the sensing element in the proximity of the sensing element, for a maximum of 10 readings. These readings shall then be averaged.

3.4.1.8 Controller Stations

The Contractor shall use the controllers' MANUAL/AUTOMATIC stations as the means of manipulating control devices, such as dampers and valves, to check IP operation and to effect stable conditions prior to making measurement checks.

3.4.1.9 Controller-Tuning Procedure

The Contractor shall perform a controller-tuning procedure, which shall consist of setting the initial proportional, integral, and derivative (PID) mode constants, controller setpoints, and logging the settings. Tuning shall be self-tuning operation by the controller unless manual tuning is necessary.

3.4.1.10 Controller Manual-Tuning Procedure

Where required, the controller manual-tuning procedure shall be performed in three steps. Using a constant-temperature-setpoint controller as an example, these steps are:

a. Step A:

(1) The controller MANUAL/AUTO station shall be indexed to the AUTO position and the integral- and derivative-mode constants set to zero.

(2) The proportional-mode constant shall be set to an initial setting of 8 percent. (This corresponds to 1.5 psig per degree F or 2.0 ma per degree F proportional controller output change for a 100 degree F transmitter span.) This causes the controller output signal to vary from live zero output to full output for an input signal change representing an 8 degree F change.

(3) Controllers for other variables, such as relative humidity and static pressure, shall have their proportional-mode constants set initially in a similar manner for an achievable output range proportional to the transmitter span.

b. Step B:

(1) The controller temperature setpoint shall be set at any achievable temperature. The controller output and transmitter input shall be observed.

(2) If the transmitter input continuously oscillates above and below the setpoint without settling at a fixed value, or if such oscillation increases, the proportional-mode constant is too small.

(3) If the proportional-mode constant is too small, increase it in steps until the transmitter input indicates stable control at any temperature, provided that the controller output is not at either extreme of the output range.

(4) If the temperature control point slowly drifts toward or away from the controller setpoint, the proportional-mode constant is too large. Its setting shall be decreased in steps until oscillations occur as described in the preceding paragraphs, and then the setting shall be increased until stable control occurs.

(5) A step change in controller setpoint shall be introduced. This should cause the controller to overshoot the setpoint slightly, with each subsequent overshoot peak value decreasing by a factor of 2/3 until stable control is achieved at, above, or below the setpoint.

(6) Next, the integral-mode constant setting shall be increased in small steps, and setpoint changes shall be introduced until control point and controller setpoint coincide at stable control. This should happen consistently after a setpoint change within a short time, such as 5 to 10 minutes.

c. Step C:

(1) Unless the HVAC process variable changes rapidly, the derivative-mode constant setting can remain at zero.

(2) If derivative control is needed, the derivative-mode constant shall be gradually increased.

(3) Step changes in controller setpoint shall be introduced, and the derivative-mode constant setting adjusted until stable control is achieved.

3.4.1.11 Setting the Controller

After the controller manual-tuning procedure is complete, the controller shall be set at the setpoint as shown.

3.4.2 Omitted.

3.4.3 Omitted.

3.4.4 Omitted.

3.4.5 Omitted.

3.4.6 Omitted.

3.4.7 Omitted.

3.4.8 Omitted.

3.4.9 Omitted.

3.4.10 Omitted.

3.4.11 Omitted.

3.4.12 Omitted.

3.4.13 Omitted.

3.4.14 Omitted.

3.4.15 Omitted.

3.4.16 Omitted.

3.4.17 Omitted.

3.4.18 Omitted.

3.4.19 Omitted.

3.4.20 Single-Zone with Dual-Temperature Coil; No Return Fan

Steps for installation shall be as follows:

a. Step 1 - System Inspection: The HVAC system shall be verified in its shutdown condition. Power and main air shall be available at the HVAC system control panel. The outside-air and relief-air dampers shall be closed, the return-air damper shall be open, and the cooling-coil valve shall be closed.

b. Step 2 - Calibration Accuracy Check with HVAC System Shutdown: Readings shall be taken with a digital thermometer at each temperature-sensing element location. Each controller display shall be read, and the thermometer and controller-display readings logged. The calibration accuracy of the sensing element-to-controller readout for outside-air, return-air, and space temperatures shall be checked.

c. Step 3 - Actuator Range Adjustments: A signal shall be applied to the actuator, using the controller MANUAL/AUTO" station in "MANUAL." The proper operation of the actuators and positioners for all dampers

and valves shall be verified. The signal shall be varied from live zero of 4 ma to 20 ma, and it shall be verified that the actuators travel from zero stroke to full stroke within the signal range. It shall be verified that all sequenced and parallel-operated actuators move from zero stroke to full stroke in the proper direction, and move the connected device in the proper direction from one extreme position to the other.

d. Step 4 - Control-System Commissioning:

(1) With the fan ready to start, the ventilation-delay-mode signal shall be applied, and it shall be verified that the ventilation-delay-mode pilot light turns on. The occupied-mode signal shall be applied, and it shall be verified that the occupied-mode pilot light turns on and that supply fan starts. It shall be verified that the outside-air and exhaust-air dampers are closed, the return-air damper is open, and the dual-temperature coil face and bypass dampers are under control, by slightly changing the controller outputs. The ventilation-delay-mode signal shall be released, and it shall be verified that the ventilation-delay-mode pilot light turns off and that the outside-air, return-air, and exhaust-air dampers come under control by changing the controller output.

(2) The minimum-outside-air-mode signal shall be applied. It shall be verified that the outside-air damper opens to minimum position.

(3) The heating-season and cooling-season space-temperature controllers "MANUAL/AUTO" stations shall be indexed to the "MANUAL" position. An economizer-mode input signal shall be simulated and it shall be verified that the economizer-mode pilot light turns on. One space-temperature controller output shall be changed and the second point of the two-point calibration accuracy check of sensing element-to-controller readout for outside-air, return-air, and space temperatures (as indicated at both space-temperature controllers) shall be performed. The controllers shall be placed in the remote-setpoint mode. The setpoint low-end limit shall be set to 66 degrees F and the high-end limit shall be set to 72 degrees F. Proper operation of the temperature setpoint device at the space-temperature sensing element and transmitter location shall be verified. The tuning procedure shall be performed for the heating-season and cooling-season space-temperature controllers. The controller "MANUAL/AUTO" station for the heating-season and cooling-season space-temperature controllers shall be indexed to the "AUTO" position and the temperature setpoint device shall be set to the space temperature setpoint as shown. Simulated signals shall be applied to check that deviation alarms of cooling-season space-temperature controllers activate at the settings shown.

(4) Omitted

(5) An unoccupied-mode signal shall be applied, and it shall be verified that the occupied-mode pilot light turns off, the HVAC system shuts down, and the control system assumes the specified shutdown conditions. The night-thermostat temperature setting shall be turned upward, and it shall be verified that the HVAC system starts; the setting shall be turned downward, and it shall be verified that the HVAC system stops. The night thermostat shall be set at the setpoint as shown.

(6) With the HVAC system running, a filter differential-pressure switch input signal shall be simulated at the device. It shall be verified that the filter pilot light turns on, and that contact output at the EMCS terminals is made. The differential-pressure switch shall be set at the setpoint as shown.

(7) With the HVAC system running, a freezestat trip input signal shall be simulated, at the device. HVAC system shutdown shall be verified. The low-temperature pilot light shall turn on; and contact output at EMCS terminals shall be verified. The freezestat shall be set at the setpoint as shown. The HVAC system shall be restarted by manual restart, and it shall be verified that the pilot light turns off.

(8) With the HVAC system running, a smoke-detector trip input signal shall be simulated at each detector, and control-device actions and interlock functions, as described in paragraph CONTROL SEQUENCES OF OPERATION shall be verified. Simulation shall be performed without false-alarms any Life Safety systems. It shall be verified that the HVAC system shuts down and that the smoke-detector pilot light turns on, and contact output at the EMCS terminals is made. The detectors shall be reset. The HVAC system shall be restarted by manual restart, and it shall be verified that the pilot light turns off.

(9) Omitted.

(10) Omitted.

3.5 BALANCING, COMMISSIONING, AND TESTING

3.5.1 Coordination with HVAC System Balancing

Commissioning of the control system, except for tuning of controllers, shall be performed prior to or simultaneous with HVAC system balancing. The Contractor shall tune the HVAC control system after all air-system balancing has been completed, minimum damper positions set and a report has been issued.

3.5.2 Control System Calibration, Adjustments, and Commissioning

Control system commissioning shall be performed for each HVAC system, using test plans and procedures previously approved by the Government. The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform commissioning and testing of the HVAC control system. All instrumentation and controls shall be calibrated and the specified accuracy shall be verified using test equipment with calibration traceable to NIST standards. Wiring shall be tested for continuity and for ground, open, and short circuits. Tubing systems shall be tested for leaks. Mechanical control devices shall be adjusted to operate as specified. HVAC control panels shall be pretested off-site as a functioning assembly ready for field connections, calibration, adjustment, and commissioning of the operational HVAC control system. Written notification of any planned commissioning or testing of the HVAC Control systems shall be given to the Government at least 14 calendar days in advance.

3.5.3 Performance Verification Test

The Contractor shall demonstrate compliance of the HVAC control system with the contract documents. Using test plans and procedures previously approved by the Government, the Contractor shall demonstrate all physical and functional requirements of the project. The performance verification test shall show, step-by-step, the actions and results demonstrating that the control systems perform in accordance with the sequences of operation. The performance verification test shall not be started until after receipt by the Contractor of written permission by the Government, based on Government approval of the commissioning report and completion of balancing. The tests shall not be conducted during scheduled seasonal off-periods of base heating and cooling systems.

3.5.4 Posted and Panel Instructions

Posted and panel instructions, showing the final installed conditions, shall be provided for each system. The posted instructions shall consist of half-size laminated drawings and shall include the control system schematic, equipment schedule, ladder diagram, sequence of operation, panel arrangement drawings, wiring diagram, and valve and damper schedules. The posted instructions shall be permanently affixed, by mechanical means, to a wall near the control panel. Panel instructions shall consist of laminated letter-size sheets and shall include a routine maintenance checklist and controller configuration check sheets with final configuration record for each controller. Panel instructions and one copy of the operation and maintenance manuals, previously described herein, shall be placed inside each control panel.

(END OF SECTION)

SECTION 15990**TESTING, ADJUSTING AND BALANCING OF HVAC SYSTEMS****PART 1 GENERAL****1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR CONDITIONING ENGINEERS
(ASHRAE)

ASHRAE 111 (1988) Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-Conditioning and Refrigeration Systems

ASSOCIATED AIR BALANCE COUNCIL (AABC)

AABC MN-1 (1989) National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB-01 (1991) Procedural Standards for Testing-Adjusting-Balancing of Environmental Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A (1993) Installation of Air Conditioning and Ventilating Systems

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA-07 (1993) HVAC Systems - Testing, Adjusting and Balancing

1.2 GENERAL REQUIREMENTS

The Contractor shall select AABC MN-1, NEBB-01, SMACNA-07 or ASHRAE 111 as the standard for providing testing, adjusting and balancing of air and water systems. The selected standard shall be used throughout the project. Testing, adjusting, and balancing shall be accomplished by a firm certified for testing and balancing by Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB). Prior to testing, adjusting, and balancing, the Contractor shall verify that the systems have been installed and are operating as specified. Approved detail drawings and all other data required for each system and/or component to be tested shall be made available at the jobsite during the entire testing, adjusting and balancing effort. The Contractor shall verify that all balancing devices are properly installed to permit testing, adjusting and balancing and that all duct leakage tests have been completed prior to testing, adjusting and balancing. The Contracting Officer shall be notified in writing of all equipment, components, or balancing devices, that are damaged, incorrectly installed, or missing, as well as any design deficiencies that will prevent proper testing, adjusting, and balancing. Testing, adjusting, and balancing shall not commence until approved by the Contracting Officer. Instrumentation accuracy shall be in accordance with the standard selected in this paragraph.

1.3 INSTRUMENT ACCURACY REQUIREMENTS

All instrumentation shall be checked for accuracy before beginning testing, adjusting and balancing procedures. Instrument accuracy shall be in accordance with the standard selected in paragraph GENERAL REQUIREMENTS. Checks may be carried out against similar equipment maintained specifically for checking purposes or by the manufacturer or a recognized testing facility. All instrumentation used for testing shall be calibrated within 6 months of use. Pitot tubes and U-tube manometers do not require checking. In no case shall the instrumentation accuracy be less than specified by the instrument manufacturer. Any instrument falling out of calibration during the process of balancing and testing shall be recalibrated or removed from the site and replaced by a properly calibrated instrument. No instruments shall be allowed to remain on-site that are not in calibration.

1.4 SUBMITTALS

The following shall be submitted for government approval:

1.4.1 Reports

1.4.1.1 Testing and Balancing;

Six copies of the final report on forms shown in AABC MN-1 or SMACNA-07, 30 days after completion of the test and balance operation. Data shall be in a hard bound cover identifying the project name, location, date of submittal, name of Contractor, and a general title indicating the specific area and type of work, and shall be signed by a registered professional engineer, employed by the test and balance firm, who has a minimum of 2 years experience in testing, adjusting and balancing work. The final report shall include a summary describing test methods, test results, and major corrective actions taken. The report shall include as-tested floor plans showing all measurement locations and types of measurements made. The air handling unit data shall include a static pressure profile diagram, and pitot tube traverses where possible. The VAV terminal data shall include maximum and minimum air flows, for design and actual conditions, and shall be supported with summaries which show the air outlet totals for each VAV terminal and the VAV terminal totals for each air handling unit. Air distribution data shall include coded drawings which show the exact location of each air outlet. Pump data shall include pump efficiency. Data for chillers, heating and cooling coils, and heat exchangers, shall include heat balance calculations.

All instruments that are recalibrated and brought back onto the jobsite after being found to be out of calibration shall have recalibration records submitted on forms shown in AABC MN-1 or SMACNA-07.

1.4.2 Certificates

1.4.2.1 Qualification;

Qualification data, 90 days prior to testing and balancing operations. The test and balance firm shall be certified by the Associated Air Balance Council (AABC) or the National Environmental Balancing Bureau (NEBB). The lead balancing technician shall be qualified by AABC or NEBB and his qualification data shall include past experience on at least five similar projects.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 TESTING AND BALANCING

3.1.1 General

The facility shall be essentially complete with final ceiling, walls, windows, doors and partitions in place. Doors and windows surrounding each area to be balanced shall be closed during testing and balancing operations. Air systems shall be complete and operable with balancing dampers, ducting, diffusers, returns, flow control boxes and control components in place. Exhaust fans and fume hoods shall be operational. Hydronic systems shall be complete and operable with balancing valves, flow meters, coils, pumps, piping and control components in place.

All measurements and adjustments shall be made using procedures described in standard selected in paragraph GENERAL REQUIREMENTS. Air motion and distribution from air terminals shall be as shown. Smoke tests may be used to demonstrate proper air distribution from air terminals. All data including deficiencies encountered and corrective action taken shall be recorded. If a system cannot be adjusted to meet the design requirements, the Contractor shall promptly notify the Contracting Officer in writing.

3.1.2 Air Systems

Clean filters shall be installed at the beginning of the testing, adjusting, and balancing effort. Each system shall be adjusted until all flow quantities are within plus ten percent and minus zero percent. Dampers shall be checked for tight shutoff. Air leakage around dampers shall be verified. Fans shall be checked for correct direction of rotation and proper speed shall be verified. Fire and smoke dampers shall be tested at system design air flow to ensure proper closure in accordance with NFPA 90A and manufacturer's instructions prior to building occupancy.

3.1.2.1 General Balancing Methods

In addition to the requirements for specific systems, flows in supply, exhaust and return air systems shall be balanced using the methods in standard selected in paragraph GENERAL REQUIREMENTS. Throttling losses shall be limited. Air flow adjustments shall be made by first adjusting the fan speed to meet the design flow conditions. Fan speed adjustment may not be required for fan motors which are less than 746 W, (one horsepower,) or if throttling results in no greater than an additional 1/3 W (horsepower) draw above that required if the fan speed were adjusted. Flows and pressures shall be checked in all main risers and supply ducts at all supply, exhaust and return fan discharges. All flows shall be recorded before and after each adjustment.

3.1.2.2 Specific Systems

All special or additional procedures for testing and balancing shall be in accordance with the applicable requirements of the standard selected in paragraph GENERAL REQUIREMENTS. If a system has diversity, only the required quantity of wide open terminals shall be used to meet the design air flow.

3.1.3 Hydronic Systems

All valves and control components shall be open or set as required for maximum system flow. Each system shall be adjusted until all flow quantities are within the tolerances of the standard selected in paragraph GENERAL REQUIREMENTS. Pumps shall be checked for proper speed. Pump activation signal and deactivation signal valves shall be verified. Pump motor current shall be checked at maximum design flow. Variable speed pumping systems shall be tested at a minimum of four separate flow conditions to simulate design diversity.

3.1.3.1 General Balancing Methods

In addition to the requirements for specific systems, flows in piping, coils and other hydronic system components shall be balanced using the flow meter, equipment pressure drop or pump curve methods in accordance with the applicable provisions of the standard selected in paragraph GENERAL REQUIREMENTS. Flows shall be checked in all main risers and branches and condenser water lines and at all heating and cooling coils, heat exchangers, boilers, chillers, and pump discharges. Pressure taps on all pumps shall be made at factory suction and discharge tappings where available. All flows shall be recorded before and after each adjustment.

3.1.3.2 Specific Systems

Where specific systems require special or additional procedures for testing and balancing, such procedures shall be in accordance with the standard selected in paragraph GENERAL REQUIREMENTS. If a system has diversity, only the required quantity of wide-open terminals shall be used to meet the design water flow.

3.1.4 Marking of Setting

Following final acceptance of certified reports by the Contracting Officer, the setting of all HVAC adjustment devices including valves, splitters, and dampers shall be permanently marked by the testing and balancing engineer so that adjustment can be restored if disturbed at any time.

3.1.5 Marking of Test Ports

The testing and balancing engineer shall permanently and legibly mark and identify the location points of the duct test ports. If the ductwork has exterior insulation, these markings shall be made on the exterior side of the ductwork insulation. All penetrations through ductwork and ductwork insulation shall be properly sealed to prevent air leakage or loss of vapor barrier.

3.2 CONTROL SYSTEMS

Testing, adjusting, and balancing of the systems shall be coordinated with the control system installation. All control components shall be verified to be properly installed and operating as specified before proceeding with testing, adjusting, and balancing. Verification shall be in accordance with AABC MN-1.

(END OF SECTION)

SECTION 16415
ELECTRICAL WORK
PART 1 GENERAL

1.1 REFERENCES

Publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C37.16	(1988; C37.16a) Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors -Preferred Ratings, Related Requirements, and Application Recommendations
ANSI C57.12.20	(1988) Overhead-Type Distribution Transformers
ANSI C80.5	(1990) Rigid Aluminum Conduit
ANSI C82.1	(1985; C82.1b; C82.1; R1992) Ballasts for fluorescent lamps Specifications
ANSI C135.30	(1988) Zinc-Coated Ferrous Ground Rods for Overhead or Underground Line Construction
ANSI 05.1	(1992) Specifications and Dimensions for wood poles

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 709	(1992) Laminated Thermosetting Materials
------------	--

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C37.13	(1990) Low-Voltage AC Power Circuit Breakers Used in Enclosures
IEEE C57.12.00	(1993) IEEE Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C62.1	(1989, R1994) Surge arresters for Ac power circuits
IEEE C62.2	(1987, R1994) Guide for the Application of gapped silicon-carbide Surge Arresters for AC systems
IEEE C62.11	(1993) IEEE Standard Metal-Oxide Surge Arresters for AC Power Circuits
IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground impedance, and Earth Surface Potentials of a Ground System Part

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1991) Enclosures for Electrical Equipment (1000 Volts Maximum)
----------	---

NEMA AB 1	(1993) Molded Case Circuit Breakers and Molded Case Switches
NEMA FU 1	(1986) Low Voltage Cartridge Fuses
NEMA ICS 1	(1993) Industrial Controls and Systems
NEMA ICS 2	(1993) Industrial Control Devices, Controllers and Assemblies
NEMA ICS 3	(1993) Industrial Systems
NEMA ICS 6	(1993) Enclosures for Industrial Control and Systems
NEMA LA 1	(1992) Surge Arresters
NEMA LE-4	(1987) Recessed Luminaires, ceiling compatibility
NEMA OS 1	(1989) Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
NEMA OS 2	(1986; Errata Aug 1986; R 1991) Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports
NEMA PB 1	(1990) Panelboards
NEMA PE 5	(1985; R1991) Utility Type Battery Chargers
NEMA RN 1	(1989) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA SG2	(1993) High Voltage Fuses
NEMA TC 2	(1990) Electrical Polyvinyl Chloride (PVC) Tubing (EPT) and Conduit (EPC-40 and EPC-80)
NEMA TC 13	(1993) Electrical Nonmetallic Tubing (ENT)
NEMA WD 1	(1983; R 1989) General Requirements for Wiring Devices
NEMA WD 6	(1988) Wiring Devices - Dimensional Requirements

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code
NFPA 90A	(1993) Installation of Air Conditioning and Ventilating Systems.
NFPA 101	(1997) Safety to Life from Fire in Buildings and Structures

UNDERWRITERS LABORATORIES (UL)

UL 1	(1993; Rev thru Jan 1995) Flexible Metal Conduit
UL 5	(1995) Surface Metal Raceways and Fittings
UL 6	(1993) Rigid Metal Conduit

UL 44	(1991; Rev thru Jan 1995) Rubber-Insulated Wires and Cables
UL 67	(1993; Rev thru Dec 1993) Panelboards
UL 83	(1991; Rev thru Oct 1994) Thermoplastic-Insulated Wires and Cables
UL 98	(1994; R Feb 1995) Enclosed and Dead-Front Switches
UL 198B	(1995) Class H Fuses
UL 198C	(1986; Rev thru Jun 1993) High-Interrupting-Capacity Fuses Current-Limiting Types
UL 198D	(1995) Class K Fuses
UL 198E	(1988; Rev Jul 1988) Class R Fuses
UL 198G	(1988; Rev May 1988) Fuses for Supplementary Overcurrent Protection
UL 198H	(1988; Rev thru Nov 1993) Class T Fuses
UL 198L	(1995) D-C Fuses for Industrial Use
UL 360	(1986; Rev thru Dec 1994) Liquid-Tight Flexible Steel Conduit
UL 467	(1993) Grounding and Bonding Equipment
UL 486A	(1991; Rev Oct 1991) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486B	(1991; Rev thru Apr 1992) Wire Connectors for Use with Aluminum Conductors
UL 486C	(1991; Rev thru Sep 1992) Splicing Wire Connectors
UL 489	(1991; Rev thru Jun 1995) Molded-Case Circuit Breakers and Circuit-Breaker Enclosures
UL 498	(1991; Rev thru Oct 1994) Attachment Plugs and Receptacles
UL 508	(1993) Industrial Control Equipment
UL 510	(1994) Insulating Tape
UL 512	(1993) Fuseholders
UL 514A	(1991; Rev Apr 1995) Metallic Outlet Boxes
UL 514B	(1992; Rev thru Apr 1995) Fittings for Conduit and Outlet Boxes
UL 514C	(1988; Rev Apr 1995) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 651	(1989; Rev thru Dec 1989) Schedule 40 and 80 Rigid PVC Conduit

UL 651A	(1995) Type EB and A Rigid PVC Conduit and HDPE Conduit
UL 719	(1985; Rev thru Dec 1994) Nonmetallic-Sheathed Cables
UL 797	(1993; Rev May 1995) Electrical Metallic Tubing
UL 817	(1994; Rev thru Aug 1994) Cord Sets and Power-Supply Cords
UL 845	(1995) Motor Control Centers
UL 857	(1994) Busways and Associated Fittings
UL 869A	(1993; Rev Apr 1994) Reference Standard for Service Equipment
UL 924	(1995) Emergency Lighting and Power Equipment
UL 935	(1995; Rev. Jun 1995) Fluorescent-lamp ballasts
UL 1242	(1983; Rev thru Jul 1993) Intermediate Metal Conduit
UL 1570	(1988) Fluorescent Lighting fixtures
UL 1571	(1991; Rev thru Mar 1995) Incandescent Lighting Fixtures
UL 1660	(1994) Liquid-Tight Flexible Nonmetallic Conduit

1.2 GENERAL

1.2.1 Rules

The installation shall conform to the requirements of NFPA 70 and NFPA 101, unless more stringent requirements are indicated herein or shown.

1.2.2 Coordination

The drawings indicate the extent and the general location and arrangement of equipment, conduit, and wiring. The Contractor shall become familiar with all details of the work and verify all dimensions in the field so that the outlets and equipment shall be properly located and readily accessible. Outlets, and other equipment and materials shall be located to avoid interference with mechanical or structural features.

1.2.3 Special Environments

1.2.3.1 Weatherproof Locations

Wiring, Fixtures, and equipment in designated locations shall conform to NFPA 70 requirements for installation in damp or wet locations.

1.2.4 Standard Products

Material and equipment shall be a standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

1.2.5 Identification Nameplates

Major items of electrical equipment and major components shall be permanently marked with an identification name to identify the equipment by type or function and specific unit number as indicated. Designation of motors shall coincide with their designation in the motor control center or panel. Unless otherwise specified, all identification nameplates shall be made of laminated plastic in accordance with ASTM D 709 with black outer layers and a white core. Edges shall be chamfered. Plates shall be fastened with black-finished round-head drive screws, except motors, or approved nonadhesive metal fasteners. When the nameplate is to be installed on an irregular-shaped object, the Contractor shall devise an approved support suitable for the application and ensure the proper installation of the supports and nameplates. In all instances, the nameplate shall be installed in a conspicuous location. At the option of the Contractor, the equipment manufacturer's standard embossed nameplate material with black paint-filled letters may be furnished in lieu of laminated plastic. The front of each panelboard, motor control center, switchgear, and switchboard shall have a nameplate to indicate the phase letter, corresponding color and arrangement of the phase conductors. The following equipment, as a minimum, shall be provided with identification nameplates:

Minimum 1/4 inch High Letters	Minimum 1/8 inch High Letters
Panelboards	Control Power Transformers
Safety Switches	Instrument Transformers
Transformers	
Equipment Enclosures	

Each panel, section, or unit in motor control centers, switchgear or similar assemblies shall be provided with a nameplate in addition to nameplates listed above, which shall be provided for individual compartments in the respective assembly, including nameplates which identify "future," "spare," and "dedicated" or "equipped spaces."

1.3 SUBMITTALS

The following shall be submitted :

Drawings

Electrical Work;

Detail drawings for all materials and equipment specified. Detail drawings shall consist of a complete list of equipment and materials, including manufacturer's descriptive and technical data; catalog cuts; and any special installation instructions that may be required.

Reports

Materials and Equipment;

The label or listing of the Underwriters Laboratories, Inc., shall be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of this label or listing, a statement from a nationally recognized, adequately equipped testing agency indicating that the items have been tested in accordance with required procedures and that the materials and equipment comply with all contract requirements will be accepted. However, materials and equipment installed in hazardous locations must bear the UL label unless the data submitted from other testing agency is specifically approved in writing by the Contracting Officer. Materials and equipment shall be approved based on the manufacturer's published data.

For other than equipment and materials specified to conform to UL publications, a manufacturer's statement indicating complete compliance with the applicable Federal Specification, or standard of the American Society for Testing and Materials, National Electrical Manufacturers Association, or other commercial standard, is acceptable.

1.4 WORKMANSHIP

Materials and equipment shall be installed in accordance with recommendations of the manufacturer and as shown.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials and equipment shall conform to the respective publications and other requirements specified below. Materials and equipment not listed below shall be as specified elsewhere in this section.

2.1.1 Busways

UL 857. Busses shall be copper .

2.1.2 Cables and Wires

Conductors in cables shall be annealed copper, except that AA-8000 series aluminum conductors may be used as an equivalent for copper conductors of No. 6 AWG or larger. Intermixing of copper and aluminum conductors in these sizes is not permitted. Design is based on copper conductors and aluminum conductors shall have an ampacity not less than that of the indicated copper conductors. Cables shall be single-conductor type, unless otherwise indicated. Cables and wires shall conform to UL 44 for rubber-insulated type; UL 83 for the thermoplastic-insulated type; and UL 719 for the nonmetallic-sheathed cables.

2.1.2.1 Metallic Armored Cable

Type ACHH or ACT.

2.1.2.2 Nonmetallic Sheathed Cables

Type NM or NMC, with ground conductor.

2.1.2.3 Service Entrance Cable

Type SE, USE.

2.1.2.4 Grounding Cables

Grounding cables shall be bare or shall have green low-voltage insulation.

2.1.2.5 Cord Sets and Power-Supply Cords

UL 817.

2.1.3 Chargers, Battery

NEMA PE 5. Battery chargers shall be general purpose, continuous current output, with solid state rectifiers. Means shall be provided to regulate and to adjust the dc output voltage. Chargers shall have continuous current rating of 10 to 15 percent higher than battery current outputs based upon an 8-hour discharge.

2.1.4 Circuit Breakers

2.1.4.1 Molded-Case and Insulated-Case Circuit Breakers

NEMA AB 1 and UL 489 for circuit breakers.

a. Molded-Case Circuit Breakers: Single-pole breakers shall be full module size; two poles shall not be installed in a single module. Multipole breakers shall be of the common-trip type having a single operating handle, but for sizes of 100 amperes or less may consist of single-pole breakers permanently factory assembled into a multipole unit having an internal, mechanical, nontamperable common-trip mechanism and external handle ties. Breakers coordinated with current-limiting fuses shall have a combined interrupting capacity of 100,000 symmetrical amperes. All poles of associated breakers shall open if any fuse blows.

b. Insulated-Case, Systems-Type Circuit Breakers: Breakers shall have continuous, short time withstand, and interrupting current ratings and frame sizes as indicated. Breakers shall have adjustable long time instantaneous solid state trip elements as indicated. Breakers shall be stored energy, manually operated type.

2.1.4.2 Low-Voltage-Power

IEEE C37.13 and ANSI C37.16. Breakers shall have continuous, short time withstand, and interrupting current ratings and frame sizes as indicated. Breakers shall have adjustable long time instantaneous solid state trip elements. Breakers shall be stored energy, manually operated, except solenoid operated breakers are permitted in 600 amperes frame or smaller electrically operated breakers.

2.1.5 Conduit and Tubing

2.1.5.1 Electrical, Zinc-Coated Steel Metallic Tubing (EMT)

UL 797.

2.1.5.2 Electrical Nonmetallic Tubing (ENT)

NEMA TC 13.

2.1.5.3 Electrical Plastic Tubing and Conduit

NEMA TC 2.

2.1.5.4 Flexible Conduit, Steel and Plastic

General-purpose type, UL 1; liquid tight, UL 360, and UL 1660

2.1.5.5 Intermediate Metal Conduit

UL 1242.

2.1.5.6 PVC Coated Rigid Steel Conduit

NEMA RN 1.

2.1.5.7 Rigid Aluminum Conduit

ANSI C80.5 and UL 6.

2.1.5.8 Rigid Metal Conduit

UL 6.

2.1.5.9 Rigid Plastic

NEMA TC 2, UL 651 and UL 651A.

2.1.5.10 Surface Metal Electrical Raceways and Fittings

UL 5.

2.1.6 Conduit and Device Boxes and Fittings

2.1.6.1 Boxes, Metallic Outlet

NEMA OS 1 and UL 514A.

2.1.6.2 Boxes, Nonmetallic, Outlet and Flush-Device Boxes and Covers

NEMA OS 2 and UL 514C.

2.1.6.3 Boxes, Switch (Enclosed), Surface-Mounted

UL 98.

2.1.6.4 Fittings for Conduit and Outlet Boxes

UL 514B.

2.1.6.5 Fittings, PVC, for Use with Rigid PVC Conduit and Tubing

UL 514B.

2.1.7 Conduit Coatings Plastic Resin System

NEMA RN 1, Type A-40.

2.1.8 Connectors, Wire Pressure

2.1.8.1 Copper Conductors

UL 486A.

2.1.8.2 Aluminum Conductors

UL 486B.

2.1.9 Electrical Grounding and Bonding Equipment

UL 467.

2.1.9.1 Ground Rods

Ground rods shall be of copper-clad steel conforming to UL 467, zinc-coated steel conforming to ANSI C135.30 solid stainless steel not less than 19.1 mm (3/4 inch) in diameter by 3.1 meter (10 feet) in length of the sectional type driven full length into the earth.

2.1.9.2 Ground Bus

The ground bus shall be bare conductor or flat copper in one piece, if practicable.

2.1.10 Enclosures

NEMA ICS 6 or NEMA 250 .

2.1.10.1 Circuit Breaker

UL 489.

2.1.11 Fixtures, Lighting and Fixture Accessories/Components Standard Drawing 40-06-04 sheets referenced hereinafter and enclosed as an integral part of these specifications, additional fixtures shown on contract drawings. Fixtures, accessories and components, including ballasts, lampholders, lamps, starters and starter holders, shall conform to industry standards specified below.

2.1.11.1 Fixture, Auxiliary or Emergency UL 924

2.1.11.2 Incandescent Fixture NEMA LE 4 for ceiling compatibility of recessed fixtures and UL 1571.

2.1.11.3 Fluorescent

a. Fixture: NEMA LE 4 for ceiling compatibility of recessed fixtures and UL 1570. Fixtures shall be plainly marked for proper lamp and ballast type to identify lamp diameter, wattage, color and start type. Marking shall be readily visible to service personnel, but not visible from normal viewing angles.

b. Ballasts: Magnetic Ballast, Energy-Saving, High Power Factor, Class P, Automatic-Resetting Type, approved for the application by the Certified Ballast Manufacturers: ANSI C82.1 and UL 935.

2.1.12 Fuses and Fuseholders

2.1.12.1 Fuses, Low Voltage Cartridge Type

NEMA FU 1.

2.1.12.2 Fuses, High-Interrupting-Capacity, Current-Limiting Type

UL 198C.

2.1.12.3 Fuses, Class K, High-Interrupting-Capacity Type

UL 198D.

2.1.12.4 Fuses, Class H

UL 198B.

2.1.12.5 Fuses, Class R

UL 198E.

2.1.12.6 Fuses, Class T

UL 198H.

2.1.12.7 Fuses for Supplementary Overcurrent Protection

UL 198G.

2.1.12.8 Fuses, D-C for Industrial Use

UL 198L.

2.1.12.9 Fuseholders

UL 512.

2.1.13 Motor Controls and Motor Control Centers

NEMA ICS 1, NEMA ICS 2, NEMA ICS 3 and NEMA ICS 6, and UL 508 and UL 845.

2.1.14 Panelboards

Dead-front construction, NEMA PB 1 and UL 67.

2.1.15 Receptacles

NEMA WD 1.

2.1.15.1 Standard Grade

UL 498.

2.1.15.2 Service Equipment

UL 869A.

2.1.16 Splice, Conductor

UL 486C.

2.1.17 Tapes

2.1.17.1 Plastic Tape

UL 510.

2.1.17.2 Rubber Tape

UL 510.

2.1.18 Transformers

IEEE C57.12.00, ANSI C57.12.20 for specific requirements for pad mounted transformers. Transformers shall be provided with necessary auxiliary mounting devices suitable for the indicated installation. Transformers shall have

four 2-1/2 percent rated Kva high-voltage taps above and below rated primary voltage. Transformer installations shall include one primary fuse cutout and one surge arrester for each phase conductor. Self-protected transformers are not acceptable.

2.1.19 SURGE ARRESTERS

Surge arresters shall comply with NEMA LA 1 and IEEE C62.1, IEEE C62.2, and IEEE C62.11.

2.1.20 FUSED CUTOUPS

Medium-voltage fuses and cutouts shall comply with NEMA SG 2 and shall be of the loadbreak open type construction rated 15kV.

2.1.21 Wiring Devices

NEMA WD 1 for general-purpose wiring devices, and NEMA WD 6 for dimensional requirements of wiring devices.

PART 3 EXECUTION

3.1 GROUNDING

Grounding shall be in conformance with NFPA 70, the contract drawings, and the following specifications.

3.1.1 Ground Rods

The resistance to ground shall be measured using the fall-of-potential method described in IEEE Std 81. The maximum resistance of a driven ground shall not exceed 25 ohms under normally dry conditions. If this resistance cannot be obtained with a single rod, 5 additional rods not less than 1.8 meters (6 feet) on centers, or if sectional type rods are used, 3 additional sections may be coupled and driven with the first rod. In high-ground-resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately. Connections below grade shall be fusion welded. Connections above grade shall be fusion welded or shall use UL 467 approved connectors.

3.1.2 Ground Bus

Ground bus shall be provided in the electrical equipment rooms as indicated. Noncurrent-carrying metal parts of transformer neutrals and other electrical [electrical] equipment shall be effectively grounded by bonding to the bus. The ground bus shall be bonded to both the entrance ground, and to a ground rod or rods as specified above having the upper ends terminating approximately 100 mm (4 inches) above the floor. Connections and splices shall be of the brazed, welded, bolted, or pressure-connector type, except that pressure connectors or bolted connections shall be used for connections to removable equipment. For raised floor equipment rooms in computer and data processing centers, a minimum of 4, one at each corner, multiple grounding systems shall be furnished. Connections shall be bolted type in lieu of thermoweld, so they can be changed as required by additions and/or alterations.

3.1.3 Grounding Conductors

A green ground wire shall be furnished regardless of the type of conduit. All equipment grounding conductors, including metallic raceway systems used as such, shall be bonded or joined together in each wiring box or equipment enclosure. Metallic raceways and grounding conductors shall be checked to assure that they are wired or bonded into a common junction. Metallic boxes and enclosures, if used, shall also be bonded to these grounding conductors by an approved means per NFPA 70. When boxes for receptacles, switches, or other utilization devices

are installed, any designated grounding terminal on these devices shall also be bonded to the equipment grounding conductor junction with a short jumper.

3.2 WIRING METHODS

3.2.1 General Requirements

Unless otherwise indicated, wiring shall consist of insulated conductors installed in rigid aluminum or rigid zinc-coated steel conduit, rigid plastic conduit, electrical metallic and/or nonmetallic tubing, or intermediate metal conduit.

3.2.2 Conduit and Tubing Systems

Conduit and tubing systems shall be installed as indicated. Conduit sizes shown are based on use of copper conductors with insulation types as described in paragraph WIRING METHODS. Minimum size of raceways shall be 15 mm 1/2 inch. Only metal conduits will be permitted when conduits are required for shielding or other special purposes indicated, or when required by conformance to NFPA 70. Nonmetallic conduit and tubing may be used in damp, wet or corrosive locations when permitted by NFPA 70 and the conduit or tubing system is provided with appropriate boxes, covers, clamps, screws or other appropriate type of fittings. Electrical metallic tubing may be installed only within buildings. Electrical metallic tubing may be installed in concrete and grout in dry locations. Electrical metallic tubing installed in concrete or grout shall be provided with concrete tight fittings. EMT shall not be installed in damp or wet locations, or the air space of exterior masonry cavity walls. Bushings, manufactured fittings or boxes providing equivalent means of protection shall be installed on the ends of all conduits and shall be of the insulating type, where required by NFPA 70. Only UL listed adapters shall be used to connect EMT to rigid metal conduit, cast boxes, and conduit bodies. Aluminum conduit may be used only where installed exposed in dry locations. Nonaluminum sleeves shall be used where aluminum conduit passes through concrete floors and firewalls. Raceways shall be concealed within finished walls, ceilings, and floors unless otherwise shown. Raceways crossing structural expansion joints shall be provided with suitable expansion fittings or other suitable means to compensate for the building expansion and contraction and to provide for continuity of grounding.

3.2.3 Exposed Raceways

Exposed raceways shall be installed parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings. Raceways under raised floors and above accessible ceilings shall be considered as exposed installations in accordance with NFPA 70 definitions.

3.2.4 Changes in Direction of Runs

Changes in direction of runs shall be made with symmetrical bends or cast-metal fittings. Field-made bends and offsets shall be made with an approved hickey or conduit-bending machine. Crushed or deformed raceways shall not be installed. Trapped raceways in damp and wet locations shall be avoided where possible. Care shall be taken to prevent the lodgment of plaster, dirt, or trash in raceways, boxes, fittings and equipment during the course of construction. Clogged raceways shall be entirely freed of obstructions or shall be replaced.

3.2.5 Supports

Metallic conduits and tubing shall be securely and rigidly fastened in place at intervals of not more than 3 meters (10 feet) and within 900 mm (3 feet) of boxes, cabinets, and fittings, with approved pipe straps, wall brackets, conduit clamps, conduit hangers, threaded C-clamps, or ceiling trapeze. C-clamps or beam clamps shall have strap or rod-type retainers. Rigid plastic conduits (if permitted as a wiring method) shall be supported as indicated above, except that they will be supported at intervals as indicated in NFPA 70. Loads and supports shall be coordinated with supporting structure to prevent damage or deformation to the structures, but no load shall be applied to joist bridging. Fastenings shall be by wood screws or screw-type nails to wood; by toggle bolts on

hollow masonry units; by expansion bolts on concrete or brick; by machine screws, welded threaded studs, heat-treated or spring-steel-tension clamps on steel work. Nail-type nylon anchors or threaded studs driven in by a powder charge and provided with lock washers and nuts may be used in lieu of expansion bolts or machine screws. Raceways or pipe straps shall not be welded to steel structures. Holes cut to a depth of more than 40 mm (1-1/2 inches) in reinforced concrete beams or to a depth of more than 20 mm (3/4 inch) in concrete joists shall avoid cutting the main reinforcing bars. Holes not used shall be filled. In partitions of light steel construction, sheet-metal screws may be used. Conduit shall not be supported using wire or nylon ties. Raceways shall be installed as a complete system and be independently supported from the structure. Upper raceways shall not be the support of lower raceways. Supporting means will not be shared between electrical raceways and mechanical piping or ducts and shall not be fastened to hung ceiling supports. Conduits shall be fastened to all sheet-metal boxes and cabinets with two locknuts where required by the NFPA 70, where insulating bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, a single locknut and bushing may be used. Threadless fittings for electrical metallic tubing shall be of a type approved for the conditions encountered. A pull wire shall be inserted in each empty raceway in which wiring is to be installed by others if the raceway is more than 15 meters (50 feet) in length and contains more than the equivalent of two 90-degree bends, or where the raceway is more than 45 meters (150 feet) in length. The pull wire shall be of No. 14 AWG zinc-coated steel, or of plastic having not less than 1.4 MPa (200 psi) (200 pound per square inch) tensile strength. Not less than 254 mm (10 inches) (10 inches) of slack shall be left at each end of the pull wire. Additional support for horizontal runs is not required when EMT rests on steel stud cutouts.

3.2.6 Cables and Conductors

Aluminum conductors shall have ampacity of not less than the copper conductors. Wire connectors of insulating material or solderless pressure connectors properly taped shall be utilized for all splices. Pressure connectors for aluminum conductors shall have tinned aluminum bodies. Aluminum contact surfaces of conductors and connectors shall be cleaned and covered with antioxidant compound prior to making of connections.

3.2.6.1 Sizes

All sizes are based on copper conductors, unless otherwise indicated. Sizes shall be not less than indicated. Branch-circuit conductors shall be not smaller than No. 12 AWG. Conductors for branch circuits of 120 volts more than 30 meters (100 feet) long and of 277 volts more than 70 meters (230 feet) long, from panel to load center, shall be no smaller than No. 10 AWG. Class 1 remote control and signal circuit conductors shall be not less than No. 14 AWG. Class 2 remote control and signal circuit conductors shall be not less than No. 16 AWG. The conductor sizes are based on the use of TW insulation for conductors smaller than No. 1/0 AWG and THW insulation for conductors No. 1/0 and larger, except where otherwise indicated.

Higher temperature rated conductors will be permitted to be used, if the UL tested temperature ratings for which the equipment in the circuit is marked are not exceeded.

Conductor sizes for nonlinear loads shall be based on the use of minimum 75 degrees C insulated conductors for branch circuits and feeders.

3.2.6.2 Power Conductor Identification

Phase conductors shall be identified by color coding. The color of the insulation on phases A, B, and C respectively (for three phase) or phases A and B respectively (for single phase) of different voltage systems shall be as follows:

120/208 volt, 3-phase: Black, red, and blue.

120/240 volt, single/phase: Black and red.

Conductor phase and voltage identification shall be made by color-coded insulation for all conductors smaller than No. 6 AWG. For conductors No. 6 AWG and larger, identification shall be made by color-coded insulation, or conductors with black insulation may be furnished and identified by the use of half-lapped bands of colored

electrical tape wrapped around the insulation for a minimum of 75 mm (3 inches) of length near the end, or other method as submitted by the Contractor and approved by the Contracting Officer. Conductor identification shall be provided within each enclosure where a tap, splice, or termination is made. Phase identification by a particular color shall be maintained continuously for the length of a circuit, including junctions.

3.2.6. 3 Control Conductor Identification

Control circuit conductor identification shall be made by color-coded insulated conductors, plastic-coated self-sticking printed markers, permanently attached stamped metal foil markers, or equivalent means as approved. Control circuit terminals of equipment shall be properly identified. Terminal and conductor identification shall match that shown on approved detail drawings. Hand lettering or marking is not acceptable.

3.3 BOXES AND SUPPORTS

Boxes shall be provided in the wiring or raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways, 101.6 by 101.6 mm (4 by 4) inch nominal size and smaller, shall be of the cast-metal hub type when located in normally wet locations, when flush and surface mounted on outside of exterior surfaces, or when located in hazardous areas.

3.3.1 Conduit Stub-Ups

Conduits stubbed up through concrete floors for connections to freestanding equipment shall be provided with a short elbow and an adjustable top or coupling threaded inside for plugs, set flush with the finished floor. Wiring shall be extended in rigid threaded conduit to equipment, except that where required, flexible conduit may be used 150 mm (6 inches) (6 inches) above the floor. Screwdriver-operated threaded flush plugs shall be installed in conduits from which no equipment connections are made to suit the devices installed.

3.4 DEVICE PLATES

One-piece type device plates shall be provided for all outlets and fittings. Plates on unfinished walls and on fittings shall be of zinc-coated sheet steel, cast-metal, or impact resistant plastic having rounded or beveled edges. Plates on finished walls shall be of steel with baked enamel finish or impact-resistant plastic and shall be ivory. Screws shall be of metal with countersunk heads, in a color to match the finish of the plate. Plates shall be installed with all four edges in continuous contact with finished wall surfaces without the use of mats or similar devices. Plaster fillings will not be permitted. Plates shall be installed with an alignment tolerance of 1.6 mm (1/16 inch). The use of sectional-type device plates will not be permitted. Plates installed in wet locations shall be gasketed and provided with a hinged, gasketed cover, unless otherwise specified.

3.5 RECEPTACLES

3.5.1 Single and Duplex.

Single and duplex receptacles shall be rated 20 amperes, 125 volts, two-pole, three-wire, grounding type with polarized parallel slots. Bodies shall be of brown or ivory to match color of switch handles in the same room or to harmonize with the color of the respective wall, and supported by mounting strap having plaster ears. Contact arrangement shall be such that contact is made on two sides of an inserted blade. Receptacle shall be side- or back-wired with two screws per terminal. The third grounding pole shall be connected to the metal mounting yoke. Switched receptacles shall be the same as other receptacles specified except that the ungrounded pole of each suitable receptacle shall be provided with a separate terminal. Only the top receptacle of a duplex receptacle shall be wired for switching application. Receptacles with ground fault circuit interrupters shall have the current rating as indicated, and shall be UL Class A type unless otherwise shown. Ground fault circuit protection shall be provided as required by NFPA 70 and as indicated on the drawings.

3.5.2 Receptacles, 60-Ampere, 250-Volt

Receptacles, single, 60-ampere, 250-volt, shall be flush molded plastic, three-pole, three-wire type, complete with appropriate mating cord-grip plug.

3.6 WALL SWITCHES

Wall switches shall be of the totally enclosed tumbler type. The wall switch handle and switch plate color shall harmonize with the color of the respective wall. Wiring terminals shall be of the screw type or of the solderless pressure type having suitable conductor-release arrangement. Not more than two switches shall be installed in a single-gang position. Switches shall be rated 20-ampere 120-volt for use on alternating current only.

3.7 LAMPS AND LIGHTING FIXTURES

Ballasted fixtures shall have ballasts which are compatible with the specific type and rating of lamps indicated and shall comply with the applicable provisions of the publications referenced.

3.7.1 Lamps

Lamps of the type, wattage, and voltage rating indicated shall be delivered to the project in the original cartons and installed in the fixtures just prior to the completion of the project.

3.7.1.1 Incandescent

Incandescent lamps shall be for 125-volt operation unless otherwise indicated.

3.7.1.2 Fluorescent

Fluorescent lamps for magnetic ballasts shall have standard cool-white color characteristics and shall be of a type that will not require starter switches. Lamps shall be of the rapid-start type unless otherwise shown or approved.

3.7.2 Fixtures

Fixtures shall be as shown in the drawing and shall conform to the following specifications. Illustrations shown on these sheets are indicative of the general type desired and are not intended to restrict selection to fixtures of any particular manufacturer. Fixtures of similar designs and equivalent energy efficiency, light distribution and brightness characteristics, and of equal finish and quality will be acceptable if approved. In suspended acoustical ceiling with fluorescent fixtures, the fluorescent emergency light fixtures shall be furnished with self-contained battery packs.

3.7.2.1 Accessories

Accessories such as straps, mounting plates, nipples, or brackets shall be provided for proper installation. Open type fluorescent fixtures with exposed lamps shall have a wire-basket type guard.

3.8 SERVICE EQUIPMENT

Service-disconnecting means shall be of the fusible safety switch type as indicated with external handle for manual operation. When service disconnecting means is a part of an assembly, the assembly shall be listed as suitable for service entrance equipment. Enclosures shall be sheet metal with hinged cover for surface mounting unless otherwise indicated.

3.9 PANELBOARDS AND LOADCENTERS

Circuit breakers and switches used as a motor disconnecting means, and not in sight of the motor and the driven machinery location, shall be capable of being locked in the open position. Door locks shall be keyed alike. Nameplates shall be as approved. Directories shall be typed to indicate loads served by each circuit and mounted in a holder behind a clear protective covering. Busses shall be copper or aluminum.

3.9.1 Loadcenters

Loadcenters shall be circuit breaker equipped.

3.9.2 Panelboards

Panelboards shall be circuit breaker equipped as indicated on the drawings.

3.10 BATTERY CHARGERS

Battery chargers shall be installed in conformance with NFPA 70.

3.11 EQUIPMENT CONNECTIONS

All wiring not furnished and installed under other sections of the specifications for the connection of electrical equipment as indicated on the drawings shall be furnished and installed under this section of the specifications. Connections shall comply with the applicable requirements of paragraph WIRING METHODS. Flexible conduits 2 m (6 feet) or less in length shall be provided to all electrical equipment subject to periodic removal, vibration, or movement and for all motors. All motors shall be provided with separate grounding conductors. Liquid-tight conduits shall be used in damp or wet locations.

3.12 Motors and Motor Control

Control equipment furnished under this section of the specifications, and shown on the drawings, shall be connected under this section of the specifications unless shown or specified otherwise. Except as otherwise specifically noted, automatic-control wiring, signaling, and protective devices are not included in this section of the specifications, but shall be furnished and installed under other sections of the specifications. Control wiring not shown on the drawings shall be furnished under the other sections of the specifications.

3.13 TESTS

After the interior-wiring-system installation is completed, and at such time as the Contracting Officer may direct, the Contractor shall conduct an operating test for approval. The equipment shall be demonstrated to operate in accordance with the requirements of this specification. Continuity test shall be conducted on the telephone wiring system. The test shall be performed in the presence of the Contracting Officer. The Contractor shall furnish all instruments and personnel required for the tests, and the Government will furnish the necessary electric power. No part of the electrical distribution system shall be energized prior to the resistance testing of that system's ground rods and submission of test results to the Contracting Officer. Test reports shall indicate the location of the rod and the resistance and the soil conditions at the time the test was performed.

(END OF SECTION)

SECTION 16721**FIRE DETECTION AND ALARM SYSTEM****PART 1 GENERAL****1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

CODE OF FEDERAL REGULATIONS (CFR)

47 CFR 15 Radio Frequency Devices

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41 (1991) Surge Voltages in Low-Voltage AC Power Circuits

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1999) National Electrical Code

NFPA 72 (1999) National Fire Alarm Code

UNDERWRITERS LABORATORIES (UL)

UL-04 (1994) Fire Protection Equipment Directory

UL 6 (1993) Rigid Metal Conduit

UL 38 (1994; Rev Jan 1994) Manually Actuated Signaling Boxes for Use with Fire-Protective Signaling Systems

UL 268 (1989; Rev May 1989) Smoke Detectors for Fire Protective Signaling Systems

UL 464 (1990) Audible Signal Appliances

UL 521 (1993) Heat Detectors for Fire Protective Signaling Systems

UL 797 (1993) Electrical Metallic Tubing

UL 864 (1991; Rev thru May 1994) Control Units for Fire-Protective Signaling Systems

UL 1242 (1983; Rev thru Jul 1993) Intermediate Metal Conduit

1.2 GENERAL REQUIREMENTS**1.2.1 Standard Products**

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall be items that have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that can provide service within 24 hours.

1.2.2 Nameplates

Major components of equipment shall have the manufacturer's name, address, type or style, voltage and current rating, and catalog number on a noncorrosive and nonheat-sensitive plate which is securely attached to the equipment.

1.2.3 Keys and Locks

Locks shall be keyed alike.

1.2.4 Tags

Tags with stamped identification number shall be furnished for keys and locks.

1.2.5 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

1.2.6 Compliance

The fire detection and internal alarm system and the central reporting system shall be configured in accordance with NFPA 72. The equipment furnished shall be compatible and be UL listed or FM approved or approved or listed by a nationally recognized testing laboratory in accordance with the applicable NFPA standards.

1.2.7 Manufacturer's Services

Services of a manufacturer's representative who is experienced in the installation, adjustment, testing, and operation of the equipment specified shall be provided. The representative shall supervise the installation, adjustment, and testing of the equipment.

1.3 SYSTEM DESIGN

1.3.1 Operation

The fire alarm and detection system shall be a complete, supervised fire alarm system. The system shall be activated into the alarm mode by actuation of any alarm initiating device. The system shall remain in the alarm mode until initiating device is reset and the fire alarm control panel is reset and restored to normal. Alarm initiating devices shall be connected to initiating device circuits (IDC), Style D, in accordance with NFPA 72. Alarm indicating appliances shall be connected to indicating appliance circuits (IAC), Style Z in accordance with NFPA 72. A two-loop conduit system shall be provided so that if any one conduit and all conductors contained in that conduit are severed all IDC or IAC on that circuit shall remain functional. A two-loop system is not applicable to the central fire alarm communication center from the local panels. All textual, audible, and visual appliances and systems shall comply with NFPA 72.

1.3.2 Operational Features

The system shall have the following operating features:

- a. Electrical supervision of alarm IDC and IAC.
- b. Electrical supervision of the primary power (ac) supply, battery voltage, placement of alarm zone module (card, PC board) within the control panel, and transmitter tripping circuit integrity.

c. Trouble buzzer and trouble lamp (light emitting diode or neon light) to activate upon a single break, open, or ground fault condition which prevents the required normal operation of the system. The trouble signal shall also operate upon loss of primary power (ac) supply, low battery voltage, removal of alarm zone module (card, PC board), and disconnection of the circuit used for transmitting alarm signals off-premises. A trouble alarm silence switch shall be provided which will silence the trouble buzzer, but will not extinguish the trouble indicator lamp. After the system returns to normal operating conditions, the trouble buzzer shall again sound until the silencing switch returns to normal position, unless automatic trouble reset is provided.

d. Transmitter disconnect switch to allow testing and maintenance of the system without activating the transmitter but shall provide a trouble signal when disconnected and a restoration signal when reconnected.

e. Evacuation alarm silencing switch or switches which, when activated, will silence alarm devices, but will not affect the zone indicating lamp nor the operation of the transmitter. This switch shall be over-ridden upon activation of a subsequent alarm from an unalarmed zone and the alarm devices will be activated.

f. Electrical supervision of circuits used for supervisory signal services. Supervision shall detect any open, short, or ground.

g. Devices indicated on plans shall be connected to a single zone.

1.3.3 Alarm Functions

An alarm condition on a circuit shall automatically initiate the following functions:

- a. Transmission of a signal over the station radio fire reporting system. A radio transmitter shall be provided.
- b. Visual indications on the fire alarm control panel.
- c. Continuous sounding of alarm notification appliances throughout the building.

1.3.4 Primary Power

Operating power shall be provided as required by paragraph Power Supply for the System. Transfer from normal to emergency power or restoration from emergency to normal power shall be fully automatic and not cause transmission of a false alarm. Loss of ac power shall not prevent transmission of a signal via the fire reporting system upon operation of any initiating circuit.

1.3.5 Battery Backup Power

Battery backup power shall be through use of rechargeable, sealed-type storage batteries and battery charger.

1.4 SUBMITTALS

The following shall be submitted:

Data

Battery;

Substantiating battery calculations for supervisory and alarm power requirements. Ampere-hour requirements for each system component and each panel component, and the battery recharging period shall be included.

Voltage Drop;

Voltage drop calculations for signaling appliance circuits to indicate that sufficient voltage is available for proper appliance operation.

Spare Parts;

Spare parts data for each different item of material and equipment specified, not later than 2 months prior to the date of beneficial occupancy. Data shall include a complete list of parts and supplies with the current unit prices and source of supply and a list of the parts recommended by the manufacturer to be replaced after 1 year of service.

Qualifications;

Qualifications, with verification of experience and license number, of a Registered Professional Engineer with at least 4 years of current experience in the design of the fire protection and detection systems. This engineer must perform the various specification items required by this section to be performed by a registered Professional Engineer.

Drawings

Fire Alarm Reporting System;

Detail drawings, signed by the Registered Professional Engineer, consisting of a complete list of equipment and material, including manufacturer's descriptive and technical literature, catalog cuts, and installation instructions. Note that the contract drawings show layouts based on typical detectors. The contractor shall check the layout based on the actual detectors to be installed and make any necessary revisions in the detail drawings. The detail drawings shall also contain complete wiring and schematic diagrams for the equipment furnished, equipment layout, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit.

Detailed point-to-point wiring diagram, signed by the Registered Professional Engineer, showing all points of connection. Diagram shall include connections between system devices, appliances, control panels, supervised devices, and all equipment that is activated or controlled by the panel.

Instructions

Fire Alarm Reporting System;

Six copies of operating instructions outlining step-by-step procedures required for system startup, operation, and shutdown. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Six copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The instructions shall include conduit layout, equipment layout and simplified wiring, and control diagrams of the system as installed. Instructions shall be approved prior to training.

Training;

Lesson plans and training data, in manual format, for the training courses.

Statements

Test Procedures;

Detailed test procedures, signed by the Registered Professional Engineer, for the fire detection and alarm system 60 days prior to performing system tests.

Reports

Testing;

Test reports in booklet form showing all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall document all readings, test results and indicate the final position of controls.

Certificates

Equipment;

Certified copies of current approvals or listings issued by UL, FM or other nationally recognized testing laboratory, showing compliance with specified NFPA standards.

Installer;

The Contractor shall provide documentation demonstrating that its fire detection and alarm system installer has been regularly engaged in the installation of fire detection and alarm systems meeting NFPA standards for a minimum of three years immediately preceding commencement of this contract. Such documentation shall specifically include proof of satisfactory performance on at least three projects similar to that required by these specifications, including the names and telephone numbers of using agency points of contact for each of these projects. Documentation shall indicate the type of each system installed and include a written certificate that each system has performed satisfactorily in the manner specified for a period of not less than 12 months following completion. All such data shall be submitted 30 days prior to commencement of installation for approval of the Contracting Officer. Listing of the installer under "Protective Signaling Services - Local, Auxiliary, Remote Station Proprietary (UUJS)" of UL-04 shall be accepted as equivalent proof of compliance with the foregoing experience requirements.

1.5 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt and dust, and any other contaminants.

PART 2 PRODUCTS

2.1 CONTROL PANEL

Control Panel shall comply with all the applicable requirements of UL 864. Panel shall be modular, installed in a surface mounted steel cabinet with hinged door and cylinder lock. Control panel shall be a clean, uncluttered, and orderly assembled panel containing all components and equipment required to provide the specified operating and supervisory functions of the system. The panel shall have prominent rigid plastic, phenolic or metal identification plates for all lamps, zones, controls, meters, fuses, and switches. Nameplates for fuses shall also include ampere rating. Separate alarm and trouble lamp shall be provided for each zone alarm located on exterior of cabinet door or be visible through the cabinet door. Control panel switches shall be within the locked cabinet. A suitable means shall be provided for testing the control panel visual indicating devices (meters or lamps). Meters and lamps shall be plainly visible when the cabinet door is closed. Signals shall be provided to indicate by zone any alarm, supervisory or trouble condition on the system. Each IDC initiating circuit shall be powered and supervised so that a signal on one zone does not prevent the receipt of signals from other zones. Loss of power, including any or all batteries, shall not require the reloading of a program. Upon restoration of power, startup shall be automatic, and shall not require any manual operation. The loss of primary power or the sequence of applying primary or emergency power shall not affect the transmission of alarm, supervisory or trouble signals.

2.1.1 Visual Annunciators

Visual annunciators shall be provided for each active zone and spare zone. 1 Spare zone shall be provided. Each lamp shall provide specific identification of the zone by means of a permanently attached rigid plastic, phenolic or metal sign with either raised or engraved letters. Zone identification shall consist of word description of the zone.

2.1.2 Cabinets

Cabinets shall be provided with ample gutter space to allow proper clearance between the cabinet and live parts of the panel equipment. If more than one modular unit is required to form a control panel, the units shall be installed in a single cabinet large enough to accommodate all units. Cabinets shall have manufacturer's standard finish and color.

2.1.3 Circuit Connections

Circuit conductors entering or leaving the panel shall be connected to screw-type terminals with each terminal marked for identification.

2.2 STORAGE BATTERIES

Storage Batteries shall be provided and shall be the sealed, lead-calcium type requiring no additional water. The batteries shall have ample capacity, with primary power disconnected, to operate the fire alarm system for a period of 48 hours. Following this period of operation via batteries, the batteries shall have ample capacity to operate all components of the system, including all alarm signaling devices in the total alarm mode for a minimum period of 15 minutes. Batteries shall be sized to deliver 50 percent more ampere/hours based on a 48 hour discharged rate than required for the calculated capacities. Batteries in the control panel shall be located at the bottom of the panel. Battery shall be provided with overcurrent protection in accordance with NFPA 72.

2.3 BATTERY CHARGER

Battery charger shall be completely automatic, with high/low charging rate, capable of restoring the batteries from full discharge to full charge within 12 hours. A separate ammeter shall be provided for indicating rate of charge. A separate voltmeter shall be provided to indicate the state of the battery charge. A pilot light indicating when batteries are manually placed on a high rate of charge shall be provided as part of the unit assembly if a high rate switch is provided. Charger shall be located in control panel or battery cabinet.

2.4 MANUAL FIRE ALARM STATIONS

Manual fire alarm stations shall conform to the applicable requirements of UL 38. Manual stations shall be connected into alarm-initiating circuits. Stations shall be installed on surface mounted outlet boxes. Stations shall be single action type. Stations shall be finished in red, with raised letter operating instructions of contrasting color. Stations requiring the breaking of glass or plastic panels for operation are not acceptable. Stations employing glass rods are acceptable. The use of a key or wrench shall be required to reset the station. Gravity or mercury switches are not acceptable. Switches and contacts shall be rated for the voltage and current upon which they operate. Stations shall have a separate screw terminal for each conductor. Surface mounted boxes shall be painted the same color as the fire alarm manual stations.

2.5 FIRE DETECTING DEVICES

Fire detecting devices shall comply with the applicable requirements of NFPA 72, NFPA 90A, UL 268, and UL 521. The detectors shall be provided as indicated. Detector base shall have screw terminals for making connections. No older connections will be allowed. Detectors shall be connected into alarm initiating circuits. Detectors located in concealed locations (above ceiling, etc.) shall have a remote visible indicator lamp. Installed devices shall conform to the classification of the area.

2.5.1 Smoke Detectors

Detectors shall be designed for detection of abnormal smoke densities. Smoke detectors shall be photoelectric type. Detectors shall contain a visible indicator lamp that shows when the unit is in alarm condition. Detectors shall not be adversely affected by vibration or pressure. Detectors shall be the plug-in type in which the detector base

contains terminals for making all wiring connections. Detectors that are in concealed (above false ceilings, etc.) locations shall have a remote visible indicator lamp.

2.6 NOTIFICATION APPLIANCES

Audible appliances shall be heavy duty and conform to the applicable requirements of UL 464. Devices shall be connected into alarm indicating circuits and shall have a separate screw terminal for each conductor. Devices shall be painted red.

2.6.1 Alarm Horns , Alarm Bells

Horns shall be surface mounted, with the matching mounting back box surface mounted vibrating type suitable for use in an electrically supervised circuit. Horns shall produce a minimum sound rating of at least 85 dBA at 10 feet. Horns used in exterior locations shall be specifically listed or approved for outdoor use and be provided with metal housing and protective grills.

2.6.2 Visual Notification Appliances

Visual notification appliances shall have high intensity optic lens and flash tubes. Strobes shall conform to current ADA requirements. Strobe shall be surface mounted.

2.6.3 Combination Audible/Visual Notification Appliances

Combination audible/visual notification appliances shall provide the same requirements as individual units except they shall mount as a unit in standard backboxes. All units shall be factory assembled. Any other audible indicating appliance employed in the fire alarm systems shall be approved by the authority having jurisdiction.

2.7 FIRE DETECTION AND ALARM SYSTEM PERIPHERAL EQUIPMENT

2.7.1 Conduit

Conduit and fittings shall comply with UL 6, UL 1242 and UL 797.

2.7.2 Wiring

Wiring for 120V ac power shall be No. 12 AWG minimum. Wiring for low voltage dc circuits shall be No. 16 AWG minimum. Power wiring (over 28 volts) and control wiring shall be isolated. All wiring shall conform to NFPA 70. System field wiring shall be solid copper and installed in metallic conduit or electrical metallic tubing, except rigid plastic conduit may be used under slab-on-grade. All conductors shall be color coded. Conductors used for the same functions shall be similarly color coded. Wiring code color shall remain uniform throughout the circuit. Pigtail or T-tap connections to alarm initiating, supervisory circuits, and alarm indicating circuits are prohibited.

2.7.3 Special Tools and Spare Parts

Special tools necessary for the maintenance of the equipment shall be furnished. Two spare fuses of each type and size required and five spare lamps and LED's of each type shall be furnished. Two percent of the total number of each different type of detector, but no less than two each, shall be furnished. Fuses and lamps shall be mounted in the fire alarm panel.

PART 3 EXECUTION

3.1 INSTALLATION

All work shall be installed as shown and in accordance with the manufacturer's diagrams and recommendations, unless otherwise specified. Smoke detectors shall not be installed until the building has been thoroughly cleaned.

3.1.1 Power Supply for the System

A single dedicated circuit connection for supplying power to each building fire alarm system shall be provided. The primary power shall be supplied as shown on the drawings. The power supply shall be equipped with a locking mechanism and marked "FIRE ALARM CIRCUIT CONTROL".

3.1.2 Wiring

Conduit size for wiring shall be in accordance with NFPA 70. Wiring for the fire alarm system shall not be installed in conduits, junction boxes, or outlet boxes with conductors of lighting and power systems. No more than one conductor shall be installed under any screw terminal. All circuit conductors entering or leaving any mounting box, outlet box enclosure or cabinet shall be connected to screw terminals with each terminal marked in accordance with the wiring diagram. Connections and splices shall be made using screw terminal blocks. The use of wire nut type connectors are prohibited in the system. Wiring within any control equipment shall be readily accessible without removing any component parts. The fire alarm equipment manufacturer's representative shall be present for the connection of wiring to the control panel.

3.1.3 Control Panel

The control panel and its assorted components shall be mounted so that no part of the enclosing cabinet is less than 12 inches nor more than 78 inches above the finished floor. All manually operable controls shall be between 36 inches to 42 inches above the finished floor. Panel shall be installed to comply with the requirements of UL 864.

3.1.4 Detectors

Detectors shall be installed in accordance with NFPA 72. Detectors shall be at least 12 inches from any part of any lighting fixture. Detectors shall be located at least 3 feet from diffusers of air handling systems. Each detector shall be provided with appropriate mounting hardware as required by its mounting location. Detectors which mount in free space shall be mounted directly to the end of the stubbed down rigid conduit drop. Conduit drops shall be firmly secured to minimize detector sway. Where length of conduit drop from ceiling or wall surface exceeds 3 feet, sway bracing shall be provided.

3.1.5 Notification Appliances

Notification appliances shall be mounted a minimum of 8 feet above the finished floor unless limited by ceiling height or otherwise indicated.

3.1.6 Radio Transmitter

Radio Fire Alarm Transmitter (Transceiver) shall be compatible with the Radio Fire Alarm Monitoring Base Station. It shall be all solid state and comply with all applicable portions of 47 CFR 15 governing type acceptance. All transmitters of a common configuration shall be interchangeable with the other devices furnished by the manufacturer. Each transmitter and interface device shall be the manufacturer's current commercial product completely assembled, wired, tested at the factory, and delivered ready for installation and operation.

3.2 OVERVOLTAGE AND SURGE PROTECTION

All equipment connected to alternating current circuits shall be protected from surges per IEEE C62.41 and NFPA 70. All cables and conductors which serve as communications links, except fiber optics, shall have surge protection circuits installed at each end. Fuses shall not be used for surge protection.

3.3 GROUNDING

Grounding shall be provided to building ground.

3.4 TESTING

The Contractor shall notify the Contracting Officer 30 days before the preliminary and acceptance tests are to be conducted. The tests shall be performed in accordance with the approved test procedures in the presence of the Contracting Officer. The control panel manufacturer's representative shall be present to supervise all tests. The Contractor shall furnish all instruments and personnel required for the tests.

3.4.1 Preliminary Tests

Upon completion of the installation, the system shall be subjected to functional and operational performance tests including tests of each installed initiating and notification appliance. Tests shall include the meggering of all system conductors to determine that the system is free from grounded, shorted, or open circuits. The megger test shall be conducted prior to the installation of fire alarm equipment. If deficiencies are found, corrections shall be made and the system shall be retested to assure that it is functional.

3.4.2 Acceptance Test

Testing shall be in accordance with NFPA 72. The recommended tests in NFPA 72 shall be considered mandatory and shall verify that all previous deficiencies have been corrected. The test shall include the following:

- a. Test of each function of the control panel.
- b. Test of each circuit in both trouble and normal modes.
- c. Tests of alarm initiating devices in both normal and trouble conditions.
- d. Tests of each control circuit and device.
- e. Tests of each alarm notification appliance.
- f. Tests of the battery charger and batteries.
- g. Complete operational tests under emergency power supply.
- h. Visual inspection of all wiring connections.
- i. Opening the circuit at each alarm initiating device and notification appliance to test the wiring supervisory feature.
- j. Ground fault
- k. Short circuit faults
- l. Stray voltage
- m. Loop resistance

3.5 TRAINING

Training course shall be provided for the operations and maintenance staff. The course shall be conducted in the building where the system is installed or as designated by the Contracting Officer. The training period shall consist

of one 2 hour session and shall start after the system is functionally completed but prior to final acceptance tests. The instructions shall cover all of the items contained in the operating and maintenance instructions.

(END OF SECTION)

SECTION E Inspection and Acceptance

CLAUSES INCORPORATED BY REFERENCE:

52.246-12 Inspection of Construction

AUG 1996

CLAUSES INCORPORATED BY FULL TEXT

52.000-4010 PRE-FINAL AND FINAL INSPECTION

a. The Contractor and Government Inspector shall conduct a joint pre-final inspection prior to requesting a final inspection. Any discrepancies noted shall be corrected prior to the final inspection. The Contracting Officer may schedule more than one pre-final inspection if determined necessary.

b. The Contractor shall request final inspection in writing to the Contracting Officer ten days before the desired date. The final inspection shall be performed with the Contractor, Government personnel and representatives of the using activity. Any discrepancies noted shall be corrected prior to final payment.

SECTION F Deliveries or Performance

CLAUSES INCORPORATED BY REFERENCE:

52.000-4017 Bona Fide Need

JUL 1999

CLAUSES INCORPORATED BY FULL TEXT

52.000-4018A COMMENCEMENT, PROSECUTION, AND COMPLETION OF WORK (TURF)

There are two phases of work required by this contract – construction work required by the specifications and the establishment of turf after completion of the first phase. Accordingly, there will be two notices to proceed issued to the Contractor.

PHASE I: The Contractor shall be required to (a) commence work under this contract within 15 calendar days after the date the Contractor receives the first Notice to Proceed, (b) prosecute the work diligently, and (c) complete the entire work ready for use not later than 180 calendar days first Notice to Proceed. The time stated for completion shall include final cleanup of the premises.

PHASE II: Completion date for this phase shall be negotiated after completion of Phase I and prior to issuance of second Notice to Proceed. Negotiated date shall be based on the parameters set forth in Technical specifications Section 02935, Establishment of Turf – Seeding.

SECTION G Contract Administration Data

CLAUSES INCORPORATED BY FULL TEXT

52.000-4005 INVOICES AND PAYMENTS

Original Invoices shall be submitted to the Contract Administration Division, 1042 William H. Wilson Ave., Ste. 219, Fort Stewart, Georgia, 31314-3300. Invoices shall cite the contract number, delivery/task order number (if applicable), quantity, price and total amount of invoice. Invoice forms may be downloaded from our homepage. <http://www.stewart.army.mil/doc/intro.htm>. In accordance with General Clause entitled "Payments under Fixed Price Construction Contracts", the contractor shall furnish the certification required by paragraph "c" on progress payments and furnish a release statement with his final invoice.

SECTION H Special Contract Requirements

CLAUSES INCORPORATED BY FULL TEXT

52.000-4000 ALTERNATE DISPUTES RESOLUTION

In furtherance of Federal policy and the Administrative Dispute Resolution Act of 1990 (ADR Act), Public Law 101-552 and FAR Clause 52.233-1, Subparagraph (d) (2) (1) (B) (2), the Contracting Officer will try to resolve all post award acquisition issues in controversy by mutual agreement of both parties. Interested parties are encouraged to use alternative dispute resolution procedures to the maximum extent practicable, in accordance with the authority and requirements of the ADR Act.

52.000-4003 EXCAVATION PERMIT

The Contracting Officer's Representative (COR) shall issue the contractor necessary excavation and utility clearances. The contractor shall request such clearances in writing to the COR not less than fifteen (15) working days prior to the date which he anticipates commencement of actual digging. A date for issuance of the excavation permit shall then be scheduled and the contractor notified. It shall be the contractor's responsibility to positively locate or define the area of excavation prior to scheduled date of excavation permit. The Contractor's superintendent shall be present at the site at the time of issuance of the excavation permit. The contractor will be given the excavation permit at the site after the existing underground utilities have been staked or otherwise positively located the same day. The contractor will not proceed with excavation of any kind until he has in his possession a copy of the following:

- a. Contract drawing(s)-showing utilities within the proposed work area(s).
- b. A completed and signed excavation permits. The excavation permit shall be valid for a period of 30 days from date of issuance or as otherwise directed by issuing authority.

Contractor shall repair any damages to utilities that were staked or positively located at no cost to the Government. Utilities not located that are damaged by the Contractor will be repaired by the Government.

52.000-4004 HOURS OF OPERATION

Normal working hours are 7:30 a.m. through 4:00 p.m. Monday through Friday excluding Federal Holidays.

Notwithstanding the provisions of the Contract Work Hours and Safety Standards Act – Overtime Compensation clause herein, work will not be permitted outside normal work hours, nor on Saturdays, Sundays or legal holidays unless approved by the Contracting Officer. Requests to work other than normal work hours for all work, except within Family Housing, must be submitted in writing a minimum of 2 work days in advance of date on which such work is anticipated. Work within Family Housing shall be performed during normal work hours except in the event of emergencies as determined by the Contracting Officer. The exclusion of work on Saturdays, Sundays, and holidays has been considered in computing the performance time of this contract. The following legal holidays are observed:

January 1 st	1 st Monday of September
3 rd Monday of January	2 nd Monday of October
3 rd Monday of February	November 11 th
Last Monday of May	4 th Thursday of November
July 4 th	December 25 th

Any other Congressional or Presidential imposed Federal Holiday.

When a holiday falls on a Sunday, the following Monday will be observed as a holiday and when a holiday falls on a Saturday, the preceding Friday is observed as a holiday by U.S. Government Agencies.

52.000-4011 REMOVAL OF CONTRACTOR PERSONNEL

The Government reserves the right to require removal of any Contractor personnel from the job site who endanger persons or property, or whose continued employment is inconsistent with the interest of military security. The Government also reserves the right to require the Contractor to remove from the job site, any employee found to be under the influence of alcohol, drugs or any other incapacitating agent or any employee involved in the theft of Government property. The removal from the job site of such personnel shall not relieve the Contractor of the requirement to provide personnel to perform services.

52.000-4012 REQUIRED INSURANCE

In accordance with FAR clause 52.228-5 entitled, "Insurance--Work on a Government Installation" the following minimum amounts of insurance are required.

Workmen's Compensation	As required by state laws
Employer's Liability Insurance	\$100,000
General Liability Insurance Bodily Injury Liability	\$500,000 per occurrence
Auto Liability Insurance	\$200,000 per person
Bodily Injury	\$500,000 per occurrence
Property Damage	\$ 20,000 per occurrence

52.000-4013 UTILITIES

Utility services required will be furnished at no cost to the Contractor. Any alternations or connections to the existing utility facilities for accomplishment of this work shall be at no additional cost to the Government. The Contractor shall remove all alterations before final acceptance of work at no expense to the Government. If utilities are not available at the job site and are required for performance, the Contractor shall provide his own generators or other necessary equipment to provide the utilities.

52.000-4015 ASBESTOS PROHIBITION

"Asbestos", including chrysotile, ammosite, crocidolite, tremolite asbestos, anthophyllite asbestos, actinolite asbestos and any of these materials that have been chemically treated and/or altered is prohibited from incorporation into the work under this contract. This prohibition does not apply to nor prevent the removal and disposal of asbestos materials.

52.000-4019 CONTRACT PROGRESS REPORTS

The contractor shall submit FORSCOM Form 59-1-R, Contract Progress Report, accompanied by a brief narrative report of work accomplished, to the Contracting Officer weekly. Each report submitted must be complete, signed and dated by the Contractor.

52.000-4024 PROGRESS SCHEDULES

The reports contemplated by the clause, FAR 52.236.15, herein entitled, "Schedules for Construction Contracts" shall be accomplished on and in accordance with instructions pertaining to FORSCOM Form 59-R when periods of performance exceed 60 calendar days.

52.000-4031 HUNTER AAF, PHYSICAL DATA

a. Data and information furnished or referred to below is for the Contractor's information. The Government is not responsible for any interpretation of or conclusion drawn from the data or information by the Contractor.

b. Weather Conditions. The following table reflects the meteorological data from the U.S. Weather Station at Fort Stewart, Georgia, and will be used to determine time extension due to abnormal weather.

HUNTER ARMY AIRFIELD, GEORGIA

Month	Avg Days Rain	Avg Inches Rainfall	No. Days Below 32 Degree F	No. Days Above 90 Degree F
JAN	9	3.2	9	0
FEB	9	3.4	5	0
MAR	9	4.2	1	0
APR	7	2.9	0	1
MAY	9	3.8	0	4
JUN	10	5.5	0	11
JUL	15	7.1	0	16
AUG	12	7.2	0	15
SEP	11	5.7	0	4
OCT	7	2.8	0	1
NOV	7	1.8	2	0
DEC	9	2.6	6	0

Average number of days of rainfall 0.01 Inch or more. Data from AWS Climatic Briefs, Period of Record Jan 75-May 98.

52.000-4053 INSTALLATION ACCESS CONTROL REQUIREMENTS (25 July 2001)

1. Contractors/Subcontractors and their employees requiring access to the installation will be required to comply with the installation access control policy/procedures. The Government will not be responsible for damages due to delay/stoppages caused by failure to comply.

2. The type of registration required will be determined by the length of time the contractor requires access to the installation.

a. Contractors requiring access to the installation in excess of 90 days will be issued a government identification card and a vehicle decal that will be displayed in the top center portion of the windshield.

b. Contractors requiring access to the installation for a period of 90 days or less will be issued a temporary vehicle permit that shall be displayed on the dash of the automobile. A government identification card will not be issued. A valid drivers license or other form of identification must be shown at the access control point in lieu of a government identification card.

c. Contractors requiring access to the installation sporadically will be required to follow the same procedures as other visitors to the installation. These contractors include but are not limited to those that are here for warranty calls, one-time deliveries, scheduled inspections, service providers, etc.

3. Government issued identification cards and vehicle registration decals/permits are government property and must be relinquished upon request of the government.

4. Procedures for Obtaining Government Issued Identification Cards and Vehicle Registration

a. Contractors Requiring Access to the Installation in Excess of 90 Days.

(1) Contractors are required, within 5 days after receipt of contract award, to furnish a personnel roster to the Directorate of Contracting (DOC). Submission via email to address provided in notice of award is preferred. Upon receipt of the personnel roster, the DOC will verify contract information and forward to the Civilian Personnel Advisory Center (CPAC). A revised roster must be provided to the DOC any time a change is made to the contractor's personnel.

(2) Contractors shall provide information for individual employee identification cards to the CPAC, 101 W Bultman Ave Ste 100, Fort Stewart, GA 31314. This shall include: employee last name, first name, middle initial; social security number, date of birth, weight, height, color hair, color eyes, and sex. Once CPAC has received this information, they will prepare the identification cards and call the contractor to schedule an appointment for employees to report to the CPAC office, Building 1191, Fort Stewart, Georgia for issuance of their identification cards. The employee will then be required to take it to the 3d SSB, ID Card Section, Building 250, (Marne Welcome Center), Fort Stewart, Georgia for photos, finger printing and lamination.

(3) After employees have been issued their government identification card, they will report to the Vehicle Registration Office at Building 288, Fort Stewart, Georgia or Building 1240, Hunter Army Airfield to obtain a vehicle registration decal. They must have a current government issued identification card as indicated above. They will also be required to show proof of ownership of the vehicle they are registering or an affidavit authorizing them to drive the vehicle, proof of insurance, current registration, and a valid driver's license.

(4) For renewal of government issued identification cards, contractors must submit request for renewal to the issuing authority. DOC will approve these requests as required by the issuing authority.

b. Contractors Requiring Access to the Installation 90 Days or Less.

(1) Contractors are required, within 5 days after receipt of contract award, to furnish a personnel roster to the DOC. Submission via email to address provided in notice of award is preferred. Upon receipt of the personnel roster, the DOC will verify the contract information and forward to the Vehicle Registration Office. A revised roster must be provided to the DOC any time a change is made to the contractor's personnel.

(2) Government issued identification cards will not be required however; individuals may be required to show some form of identification at the access control point.

(3) Once the Vehicle Registration Office has received contract verification and the personnel roster, employees will report to the Vehicle Registration Office at Building 285, Fort Stewart, Georgia or Building 1240, Hunter Army Airfield to obtain a temporary vehicle registration permit. They must be listed on the personnel roster and will be required to show proof of ownership of the vehicle they are registering or an affidavit authorizing them to drive the vehicle, proof of insurance, current registration, and a valid driver's license.

5. Upon termination of an employee or expiration of the contract, government issued identification cards must be turned in to the DOC. Contractor employees are required to report to the Vehicle Registration Office for clearance and to turn in the decal/permit.

6. The Contractor shall, under regulations prescribed by the Directorate of Public Safety (DPS); use only established roadways when transporting personnel and/or material in the prosecution of work. The Contractor shall adhere strictly to the above, and shall not develop new ingress or egress roads without specific written instructions from the DPS.

7. At times, depending on the level of access control, it might take longer than normal to get on or off the installation. Such time periods are not to be considered the basis of a claim against the government.

52.000-4054 IDENTIFICATION BADGES (25 Jul 2001)

The Contractor shall provide each employee an Identification (ID) Badge, which includes the Company Name, Employee Name and a color photo of the employee. ID Badges for Key Personnel shall also indicate their job title. ID Badges are to be worn at all times the employee is performing work under this contract. Each Contractor employee shall wear the ID Badge in a conspicuous place on the front of exterior clothing and above the waist except when safety or health reasons prohibit. Contractor is responsible for collection of ID Badges upon completion of contract or termination of employee.

52.000-4006a MATERIAL APPROVAL SUBMITTALS

The submittals contemplated by FAR clause 52.236-5 entitled, "Materials and Workmanship", and listed at Technical Exhibit #2 or any requested deviations from the Technical Provisions shall be submitted on ENG Form 4025-R, "Transmittal of Shop Drawings, Equipment Data, Material Samples, or Manufacturer's Certifications". Required certificates, manufacturing brochures, etc., shall be submitted in five (5) copies unless otherwise specified. Submittals requiring manufacturer's certifications must be executed by an officer of the manufacturing company and notarized. Approval of materials or equipment not noted as a deviation shall not relieve the Contractor from complying with the applicable Technical Provisions.

52.000-4020a FIRE PREVENTION

The Contractor shall comply with fire prevention practices as set forth by the National Fire Protection Association in the National Fire Code and other recognized fire prevention agencies and post regulations.

52.000-4026a SALVAGE AND DISPOSAL OF MATERIALS

- a. Salvage materials, unless otherwise specified, become the property of the contractor upon removal from the job site and should be taken into consideration in formulating bids.
- b. Salvage materials to remain as Government property are None
- c. Material not salvageable shall be removed from the job site and shall be disposed of off of Government property to include vegetation, rocks, trash and garbage.

SECTION I Contract Clauses

CLAUSES INCORPORATED BY REFERENCE:

52.202-1 Alt I	Definitions (May 2001) --Alternate I	MAY 2001
52.203-3	Gratuities	APR 1984
52.203-5	Covenant Against Contingent Fees	APR 1984
52.203-6	Restrictions On Subcontractor Sales To The Government	JUL 1995
52.203-7	Anti-Kickback Procedures	JUL 1995
52.203-8	Cancellation, Rescission, and Recovery of Funds for Illegal or Improper Activity	JAN 1997
52.203-10	Price Or Fee Adjustment For Illegal Or Improper Activity	JAN 1997
52.203-12	Limitation On Payments To Influence Certain Federal Transactions	JUN 1997
52.204-4	Printed or Copied Double-Sided on Recycled Paper	AUG 2000
52.209-6	Protecting the Government's Interest When Subcontracting With Contractors Debarred, Suspended, or Proposed for Debarment	JUL 1995
52.211-18	Variation in Estimated Quantity	APR 1984
52.214-29	Order Of Precedence--Sealed Bidding	JAN 1986
52.219-8	Utilization of Small Business Concerns	OCT 2000
52.222-3	Convict Labor	AUG 1996
52.222-4	Contract Work Hours and Safety Standards Act - Overtime Compensation	SEP 2000
52.222-6	Davis Bacon Act	FEB 1995
52.222-7	Withholding of Funds	FEB 1988
52.222-8	Payrolls and Basic Records	FEB 1988
52.222-9	Apprentices and Trainees	FEB 1988
52.222-10	Compliance with Copeland Act Requirements	FEB 1988
52.222-11	Subcontracts (Labor Standards)	FEB 1988
52.222-12	Contract Termination-Debarment	FEB 1988
52.222-13	Compliance with Davis-Bacon and Related Act Regulations.	FEB 1988
52.222-14	Disputes Concerning Labor Standards	FEB 1988
52.222-15	Certification of Eligibility	FEB 1988
52.222-21	Prohibition Of Segregated Facilities	FEB 1999
52.222-26	Equal Opportunity	FEB 1999
52.222-27	Affirmative Action Compliance Requirements for Construction	FEB 1999
52.222-35	Affirmative Action For Disabled Veterans And Veterans of the Vietnam Era	APR 1998
52.222-36	Affirmative Action For Workers With Disabilities	JUN 1998
52.222-37	Employment Reports On Disabled Veterans And Veterans Of The Vietnam Era	JAN 1999
52.223-5	Pollution Prevention and Right-to-Know Information	APR 1998
52.223-6	Drug Free Workplace	MAY 2001
52.223-14	Toxic Chemical Release Reporting	OCT 2000
52.225-9	Buy American Act--Balance of Payments Program--Construction Materials	FEB 2000
52.225-13	Restrictions on Certain Foreign Purchases	JUL 2000
52.227-1	Authorization and Consent	JUL 1995
52.227-2	Notice And Assistance Regarding Patent And Copyright Infringement	AUG 1996
52.228-2	Additional Bond Security	OCT 1997
52.228-5	Insurance - Work On A Government Installation	JAN 1997
52.228-11	Pledges Of Assets	FEB 1992

52.228-12	Prospective Subcontractor Requests for Bonds	OCT 1995
52.228-14	Irrevocable Letter of Credit	DEC 1999
52.228-15	Performance and Payment Bonds--Construction	JUL 2000
52.229-3	Federal, State And Local Taxes	JAN 1991
52.229-5	Taxes--Contracts Performed In U S Possessions Or Puerto Rico	APR 1984
52.232-5	Payments under Fixed-Price Construction Contracts	MAY 1997
52.232-17	Interest	JUN 1996
52.232-23	Assignment Of Claims	JAN 1986
52.232-27	Prompt Payment for Construction Contracts	MAY 2001
52.233-1	Disputes	DEC 1998
52.233-3	Protest After Award	AUG 1996
52.236-2	Differing Site Conditions	APR 1984
52.236-3	Site Investigation and Conditions Affecting the Work	APR 1984
52.236-5	Material and Workmanship	APR 1984
52.236-6	Superintendence by the Contractor	APR 1984
52.236-7	Permits and Responsibilities	NOV 1991
52.236-8	Other Contracts	APR 1984
52.236-9	Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements	APR 1984
52.236-10	Operations and Storage Areas	APR 1984
52.236-11	Use and Possession Prior to Completion	APR 1984
52.236-12	Cleaning Up	APR 1984
52.236-13 Alt I	Accident Prevention (Nov 1991) - Alternate I	NOV 1991
52.236-15	Schedules for Construction Contracts	APR 1984
52.236-21 Alt I	Specifications and Drawings for Construction (Feb 97) - Alternate I	APR 1984
52.236-26	Preconstruction Conference	FEB 1995
52.242-13	Bankruptcy	JUL 1995
52.242-14	Suspension of Work	APR 1984
52.243-4	Changes	AUG 1987
52.245-2	Government Property (Fixed Price Contracts)	DEC 1989
52.246-21	Warranty of Construction	MAR 1994
52.248-3	Value Engineering-Construction	FEB 2000
52.249-2 Alt I	Termination for Convenience of the Government (Fixed-Price) (Sep 1996) - Alternate I	SEP 1996
52.249-10	Default (Fixed-Price Construction)	APR 1984
52.253-1	Computer Generated Forms	JAN 1991
252.201-7000	Contracting Officer's Representative	DEC 1991
252.203-7001	Prohibition On Persons Convicted of Fraud or Other Defense-Contract-Related Felonies	MAR 1999
252.204-7003	Control Of Government Personnel Work Product	APR 1992
252.205-7000	Provisions Of Information To Cooperative Agreement Holders	DEC 1991
252.209-7000	Acquisition From Subcontractors Subject To On-Site Inspection Under The Intermediate Range Nuclear Forces (INF) Treaty	NOV 1995
252.209-7004	Subcontracting With Firms That Are Owned or Controlled By The Government of a Terrorist Country	MAR 1998
252.223-7006	Prohibition On Storage And Disposal Of Toxic And Hazardous Materials	APR 1993
252.225-7012	Preference For Certain Domestic Commodities	AUG 2000
252.227-7033	Rights in Shop Drawings	APR 1966
252.236-7000	Modification Proposals-Price Breakdown	DEC 1991
252.242-7000	Postaward Conference	JUL 1999
252.243-7001	Pricing Of Contract Modifications	DEC 1991
252.243-7002	Requests for Equitable Adjustment	MAR 1998
252.247-7023	Transportation of Supplies by Sea	MAR 2000
252.247-7024	Notification Of Transportation Of Supplies By Sea	MAR 2000

CLAUSES INCORPORATED BY FULL TEXT

52.211-12 LIQUIDATED DAMAGES--CONSTRUCTION (SEP 2000)

(a) If the Contractor fails to complete the work within the time specified in the contract, the Contractor shall pay liquidated damages to the Government in the amount of \$101.00 for each calendar day of delay until the work is completed or accepted.

(b) If the Government terminates the Contractor's right to proceed, liquidated damages will continue to accrue until the work is completed. These liquidated damages are in addition to excess costs of repurchase under the Termination clause.

(End of clause)

52.228-1 BID GUARANTEE (SEP 1996)

(a) Failure to furnish a bid guarantee in the proper form and amount, by the time set for opening of bids, may be cause for rejection of the bid.

(b) The bidder shall furnish a bid guarantee in the form of a firm commitment, e.g., bid bond supported by good and sufficient surety or sureties acceptable to the Government, postal money order, certified check, cashier's check, irrevocable letter of credit, or, under Treasury Department regulations, certain bonds or notes of the United States. The Contracting Officer will return bid guarantees, other than bid bonds, (1) to unsuccessful bidders as soon as practicable after the opening of bids, and (2) to the successful bidder upon execution of contractual documents and bonds (including any necessary coinsurance or reinsurance agreements), as required by the bid as accepted.

(c) The amount of the bid guarantee shall be 20% percent of the bid price or \$3,000,000.00 whichever is less.

(d) If the successful bidder, upon acceptance of its bid by the Government within the period specified for acceptance, fails to execute all contractual documents or furnish executed bond(s) within 10 days after receipt of the forms by the bidder, the Contracting Officer may terminate the contract for default.

(e) In the event the contract is terminated for default, the bidder is liable for any cost of acquiring the work that exceeds the amount of its bid, and the bid guarantee is available to offset the difference.

252.236-7001 CONTRACT DRAWINGS AND SPECIFICATIONS. (AUG 2000)

(a) The Government will provide to the Contractor, without charge, one set of contract drawings and specifications, except publications incorporated into the technical provisions by reference, in electronic or paper media as chosen by the Contracting Officer.

(b) The Contractor shall—

(1) Check all drawings furnished immediately upon receipt;

(2) Compare all drawings and verify the figures before laying out the work;

(3) Promptly notify the Contracting Officer of any discrepancies;

(4) Be responsible for any errors which might have been avoided by complying with this paragraph (b) and

(5) Reproduce and print contract drawings and specifications as needed

(c) In general--

- (1) Large-scale drawings shall govern small-scale drawings; and
- (2) The Contractor shall follow figures marked on drawings in preference to scale measurements.
- (d) Omissions from the drawings or specifications or the misdescription of details of work that are manifestly necessary to carry out the intent of the drawings and specifications, or that are customarily performed, shall not relieve the contractor from performing such omitted or misdescribed details of the work. The contractor shall perform such details as if fully and correctly set forth and described in the drawings and specifications.
- (e) The work shall conform to the specifications and the contract drawings identified on the following index of drawings:

Title File and Drawing No.

H-1253 CONSTRUCT ENVIRONMENTAL BLDG 615, HAAF, GA

(End of Clause)

SECTION J List of Documents, Exhibits and Other Attachments

Section J Table Of Contents

DOCUMENT TYPE	DESCRIPTION	PAGES	DATE
Attachment 1	TE-1 DOC Submittal List 1		JUL-31-2001
Attachment 2	TE-2 Material Submittal List	3	JUL-31-2001
Attachment 3	TE-3 Wage Decision	2	AUG-13-2001

SECTION K Representations, Certifications and Other Statements of Offerors

CLAUSES INCORPORATED BY FULL TEXT

52.204-3 TAXPAYER IDENTIFICATION (OCT 1998)

(a) Definitions.

Common parent, as used in this provision, means that corporate entity that owns or controls an affiliated group of corporations that files its Federal income tax returns on a consolidated basis, and of which the offeror is a member.

Taxpayer Identification Number (TIN), as used in this provision, means the number required by the Internal Revenue Service (IRS) to be used by the offeror in reporting income tax and other returns. The TIN may be either a Social Security Number or an Employer Identification Number.

(b) All offerors must submit the information required in paragraphs (d) through (f) of this provision to comply with debt collection requirements of 31 U.S.C. 7701(c) and 3325(d), reporting requirements of 26 U.S.C. 6041, 6041A, and 6050M, and implementing regulations issued by the IRS. If the resulting contract is subject to the payment reporting requirements described in Federal Acquisition Regulation (FAR) 4.904, the failure or refusal by the offeror to furnish the information may result in a 31 percent reduction of payments otherwise due under the contract.

(c) The TIN may be used by the Government to collect and report on any delinquent amounts arising out of the offeror's relationship with the Government (31 U.S.C. 7701(c)(3)). If the resulting contract is subject to the payment reporting requirements described in FAR 4.904, the TIN provided hereunder may be matched with IRS records to verify the accuracy of the offeror's TIN.

(d) Taxpayer Identification Number (TIN).

___ TIN:-----

___ TIN has been applied for.

___ TIN is not required because:

___ Offeror is a nonresident alien, foreign corporation, or foreign partnership that does not have income effectively connected with the conduct of a trade or business in the United States and does not have an office or place of business or a fiscal paying agent in the United States;

___ Offeror is an agency or instrumentality of a foreign government;

___ Offeror is an agency or instrumentality of the Federal Government.

(e) Type of organization.

___ Sole proprietorship;

___ Partnership;

___ Corporate entity (not tax-exempt);

___ Corporate entity (tax-exempt);

___ Government entity (Federal, State, or local);

___ Foreign government;

___ International organization per 26 CFR 1.6049-4;

___ Other-----

(f) Common parent.

___ Offeror is not owned or controlled by a common parent as defined in paragraph (a) of this provision.

___ Name and TIN of common parent:

Name-----

TIN-----

(End of provision)

52.204-5 WOMEN-OWNED BUSINESS (OTHER THAN SMALL BUSINESS) (MAY 1999)

(a) Definition. Women-owned business concern, as used in this provision, means a concern that is at least 51 percent owned by one or more women; or in the case of any publicly owned business, at least 51 percent of its stock is owned by one or more women; and whose management and daily business operations are controlled by one or more women.

(b) Representation. [Complete only if the offeror is a women-owned business concern and has not represented itself as a small business concern in paragraph (b)(1) of FAR 52.219-1, Small Business Program Representations, of this solicitation.] The offeror represents that it () is a women-owned business concern.

(End of provision)

52.209-5 CERTIFICATION REGARDING DEBARMENT, SUSPENSION, PROPOSED DEBARMENT, AND OTHER RESPONSIBILITY MATTERS (APR 2001)

(a)(1) The Offeror certifies, to the best of its knowledge and belief, that--

(i) The Offeror and/or any of its Principals--

(A) Are () are not () presently debarred, suspended, proposed for debarment, or declared ineligible for the award of contracts by any Federal agency;

(B) Have () have not (), within a three-year period preceding this offer, been convicted of or had a civil judgment rendered against them for: commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, state, or local) contract or subcontract; violation of Federal or state antitrust statutes relating to the submission of offers; or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, tax evasion, or receiving stolen property; and

(C) Are () are not () presently indicted for, or otherwise criminally or civilly charged by a governmental entity with, commission of any of the offenses enumerated in subdivision (a)(1)(i)(D) of this provision.

(ii) The Offeror has () has not (), within a three-year period preceding this offer, had one or more contracts terminated for default by any Federal agency.

(D) Have () have not (), within a three-year period preceding this offer, been convicted of or had a civil judgment rendered against them for: commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, state, or local) contract or subcontract; violation of Federal or state antitrust statutes relating to the submission of offers; or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, tax evasion, or receiving stolen property; and

(E) Are () are not () presently indicted for, or otherwise criminally or civilly charged by a governmental entity with, commission of any of the offenses enumerated in subdivision (a)(1)(i)(B) of this provision.

(2) "Principals," for the purposes of this certification, means officers; directors; owners; partners; and, persons having primary management or supervisory responsibilities within a business entity (e.g., general manager; plant manager; head of a subsidiary, division, or business segment, and similar positions).

THIS CERTIFICATION CONCERNS A MATTER WITHIN THE JURISDICTION OF AN AGENCY OF THE UNITED STATES AND THE MAKING OF A FALSE, FICTITIOUS, OR FRAUDULENT CERTIFICATION MAY RENDER THE MAKER SUBJECT TO PROSECUTION UNDER SECTION 1001, TITLE 18, UNITED STATES CODE.

(b) The Offeror shall provide immediate written notice to the Contracting Officer if, at any time prior to contract award, the Offeror learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstances.

(c) A certification that any of the items in paragraph (a) of this provision exists will not necessarily result in withholding of an award under this solicitation. However, the certification will be considered in connection with a determination of the Offeror's responsibility. Failure of the Offeror to furnish a certification or provide such additional information as requested by the Contracting Officer may render the Offeror nonresponsible.

(d) Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render, in good faith, the certification required by paragraph (a) of this provision. The knowledge and information of an Offeror is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

(e) The certification in paragraph (a) of this provision is a material representation of fact upon which reliance was placed when making award. If it is later determined that the Offeror knowingly rendered an erroneous certification, in addition to other remedies available to the Government, the Contracting Officer may terminate the contract resulting from this solicitation for default.

(End of provision)

52.219-1 SMALL BUSINESS PROGRAM REPRESENTATIONS (MAY 2001) ALTERNATE I (OCT 2000)

(a)(1) The North American Industry Classification System (NAICS) code for this acquisition is 233320.

(2) The small business size standard is \$27.5 M.

(3) The small business size standard for a concern which submits an offer in its own name, other than on a construction or service contract, but which proposes to furnish a product which it did not itself manufacture, is 500 employees.

(b) Representations. (1) The offeror represents as part of its offer that it () is, () is not a small business concern.

(2) (Complete only if the offeror represented itself as a small business concern in paragraph (b)(1) of this provision.) The offeror represents, for general statistical purposes, that it () is, () is not a small disadvantaged business concern as defined in 13 CFR 124.1002.

(3) (Complete only if the offeror represented itself as a small business concern in paragraph (b)(1) of this provision.) The offeror represents as part of its offer that it () is, () is not a women-owned small business concern.

(4) (Complete only if the offeror represented itself as a small business concern in paragraph (b)(1) of this provision.) The offeror represents as part of its offer that it () is, () is not a veteran-owned small business concern.

(5) (Complete only if the offeror represented itself as a veteran-owned small business concern in paragraph (b)(4) of this provision.) The offeror represents as part of its offer that it () is, () is not a service-disabled veteran-owned small business concern.

(6) (Complete only if offeror represented itself as small business concern in paragraph (b)(1) of this provision). The offeror represents, as part of its offer, that--

(i) It () is, () is not a HUBZone small business concern listed, on the date of this representation, on the List of Qualified HUBZone Small Business Concerns maintained by the Small Business Administration, and no material change in ownership and control, principal office, or HUBZone employee percentage has occurred since it was certified by the Small Business Administration in accordance with 13 CFR Part 126; and

(ii) It () is, () is not a joint venture that complies with the requirements of 13 CFR Part 126, and the representation in paragraph (b)(6)(i) of this provision is accurate for the HUBZone small business concern or concerns that are participating in the joint venture. (The offeror shall enter the name or names of the HUBZone small business concern or concerns that are participating in the joint venture: _____.) Each HUBZone small business concern participating in the joint venture shall submit a separate signed copy of the HUBZone representation.

(c) Definitions. As used in this provision--

Service-disabled veteran-owned small business concern--

(1) Means a small business concern--

(i) Not less than 51 percent of which is owned by one or more service-disabled veterans or, in the case of any publicly owned business, not less than 51 percent of the stock of which is owned by one or more service-disabled veterans; and

(ii) The management and daily business operations of which are controlled by one or more service-disabled veterans or, in the case of a veteran with permanent and severe disability, the spouse or permanent caregiver of such veteran.

(2) Service-disabled veteran means a veteran, as defined in 38 U.S.C. 101(2), with a disability that is service-connected, as defined in 38 U.S.C. 101(16).

Small business concern means a concern, including its affiliates, that is independently owned and operated, not dominant in the field of operation in which it is bidding on Government contracts, and qualified as a small business under the criteria in 13 CFR Part 121 and the size standard in paragraph (a) of this provision.

Veteran-owned small business concern means a small business concern--

(1) Not less than 51 percent of which is owned by one or more veterans (as defined at 38 U.S.C. 101(2)) or, in the case of any publicly owned business, not less than 51 percent of the stock of which is owned by one or more veterans; and

(2) The management and daily business operations of which are controlled by one or more veterans.

Women-owned small business concern means a small business concern --

(1) That is at least 51 percent owned by one or more women; in the case of any publicly owned business, at least 51 percent of the stock of which is owned by one or more women; and

(2) Whose management and daily business operations are controlled by one or more women.

(d) Notice.

(1) If this solicitation is for supplies and has been set aside, in whole or in part, for small business concerns, then the clause in this solicitation providing notice of the set-aside contains restrictions on the source of the end items to be furnished.

(2) Under 15 U.S.C. 645(d), any person who misrepresents a firm's status as a small, HUBZone small, small disadvantaged, or women-owned small business concern in order to obtain a contract to be awarded under the preference programs established pursuant to section 8(a), 8(d), 9, or 15 of the Small Business Act or any other provision of Federal law that specifically references section 8(d) for a definition of program eligibility, shall--

(i) Be punished by imposition of fine, imprisonment, or both;

(ii) Be subject to administrative remedies, including suspension and debarment; and

(iii) Be ineligible for participation in programs conducted under the authority of the Act.

(End of provision)

52.219-2 EQUAL LOW BIDS. (OCT 1995)

(a) This provision applies to small business concerns only.

(b) The bidder's status as a labor surplus area (LSA) concern may affect entitlement to award in case of tie bids. If the bidder wishes to be considered for this priority, the bidder must identify, in the following space, the LSA in which the costs to be incurred on account of manufacturing or production (by the bidder or the first-tier subcontractors) amount to more than 50 percent of the contract price.

(c) Failure to identify the labor surplus area as specified in paragraph (b) of this provision will preclude the bidder from receiving priority consideration. If the bidder is awarded a contract as a result of receiving priority consideration under this provision and would not have otherwise received award, the bidder shall perform the contract or cause the contract to be performed in accordance with the obligations of an LSA concern.

52.219-19 SMALL BUSINESS CONCERN REPRESENTATION FOR THE SMALL BUSINESS COMPETITIVENESS DEMONSTRATION PROGRAM (OCT 2000)

(a) Definition.

"Emerging small business" as used in this solicitation, means a small business concern whose size is no greater than 50 percent of the numerical size standard applicable to the North American Industry Classification System (NAICS) code assigned to a contracting opportunity.

(b) [Complete only if the Offeror has represented itself under the provision at 52.219-1 as a small business concern under the size standards of this solicitation.] The Offeror [] is, [] is not an emerging small business.

(c) (Complete only if the Offeror is a small business or an emerging small business, indicating its size range.)

Offeror's number of employees for the past 12 months (check this column if size standard stated in solicitation is expressed in terms of number of employees) or Offeror's average annual gross revenue for the last 3 fiscal years (check this column if size standard stated in solicitation is expressed in terms of annual receipts). (Check one of the following.)

No. of Employees Avg. Annual Gross Revenues

☐ 50 or fewer ☐ \$1 million or less
☐ 51 - 100 ☐ \$1,000,001 - \$2 million
☐ 101 - 250 ☐ \$2,000,001 - \$3.5 million
☐ 251 - 500 ☐ \$3,500,001 - \$5 million
☐ 501 - 750 ☐ \$5,000,001 - \$10 million
☐ 751 - 1,000 ☐ \$10,000,001 - \$17 million
☐ Over 1,000 ☐ Over \$17 million

(End of provision)

52.222-22 PREVIOUS CONTRACTS AND COMPLIANCE REPORTS (FEB 1999)

The offeror represents that --

(a) ☐ It has, ☐ has not participated in a previous contract or subcontract subject to the Equal Opportunity clause of this solicitation;

(b) ☐ It has, ☐ has not, filed all required compliance reports; and

(c) Representations indicating submission of required compliance reports, signed by proposed subcontractors, will be obtained before subcontract awards.

(End of provision)

52.223-13 CERTIFICATION OF TOXIC CHEMICAL RELEASE REPORTING (OCT 2000)

(a) Submission of this certification is a prerequisite for making or entering into this contract imposed by Executive Order 12969, August 8, 1995.

(b) By signing this offer, the offeror certifies that--

(1) As the owner or operator of facilities that will be used in the performance of this contract that are subject to the filing and reporting requirements described in section 313 of the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) (42 U.S.C. 11023) and section 6607 of the Pollution Prevention Act of 1990 (PPA) (42 U.S.C. 13106), the offeror will file and continue to file for such facilities for the life of the contract the Toxic Chemical Release Inventory Form (Form R) as described in sections 313(a) and (g) of EPCRA and section 6607 of PPA; or

(2) None of its owned or operated facilities to be used in the performance of this contract is subject to the Form R filing and reporting requirements because each such facility is exempt for at least one of the following reasons: (Check each block that is applicable.)

☐ (i) The facility does not manufacture, process or otherwise use any toxic chemicals listed under section 313(c) of EPCRA, 42 U.S.C. 11023(c);

☐ (ii) The facility does not have 10 or more full-time employees as specified in section 313.(b)(1)(A) of EPCRA 42 U.S.C. 11023(b)(1)(A);

☐ (iii) The facility does not meet the reporting thresholds of toxic chemicals established under section 313(f) of EPCRA, 42 U.S.C. 11023(f) (including the alternate thresholds at 40 CFR 372.27, provided an appropriate certification form has been filed with EPA);

☐ (iv) The facility does not fall within Standard Industrial Classification Code (SIC) major groups 20 through 39 or their corresponding North American Industry Classification System (NAICS) sectors 31 through 33; or

☐ (v) The facility is not located within any State of the United States, the District of Columbia, the Commonwealth of Puerto Rico, Guam, American Samoa, the United States Virgin Islands, the Northern Mariana Islands, or any other territory or possession over which the United States has jurisdiction.

252.209-7003 COMPLIANCE WITH VETERANS' EMPLOYMENT REPORTING REQUIREMENTS (MAR 1998)

By submission of its offer, the offeror represents that, if it is subject to the reporting requirements of 37 U.S.C. 4212(d) (i.e., the VETS-100 report required by Federal Acquisition Regulation clause 52.222-37, Employment Reports on Disabled Veterans and Veterans of the Vietnam Era), it has submitted the most recent report required by 38 U.S.C. 4212(d).

252.225-7031 SECONDARY ARAB BOYCOTT OF ISRAEL (JUN 1992)

(a) Definitions. As used in this clause--

(1) "Foreign person" means any person other than a United States person as defined in Section 16(2) of the Export Administration Act of 1979 (50 U.S.C. App. Sec 2415).

(2) "United States person" is defined in Section 16(2) of the Export Administration Act of 1979 and means any United States resident or national (other than an individual resident outside the United States and employed by other than a United States person), any domestic concern (including any permanent domestic establishment of any foreign concern), and any foreign subsidiary or affiliate (including any permanent foreign establishment) of any domestic concern which is controlled in fact by such domestic concerns, as determined under regulations of the President.

(b) Certification. By submitting this offer, the Offeror, if a foreign person, company or entity, certifies that it--

(1) Does not comply with the Secondary Arab Boycott of Israel; and

(2) Is not taking or knowingly agreeing to take any action, with respect to the Secondary Boycott of Israel by Arab countries, which 50 U.S.C. App. Sec 2407(a) prohibits a United States person from taking.

(End of clause)

252.247-7022 REPRESENTATION OF EXTENT OF TRANSPORTATION BY SEA (AUG 1992)

(a) The Offeror shall indicate by checking the appropriate blank in paragraph (b) of this provision whether transportation of supplies by sea is anticipated under the resultant contract. The term supplies is defined in the

Transportation of Supplies by Sea clause of this solicitation.

(b) Representation. The Offeror represents that it:

____ (1) Does anticipate that supplies will be transported by sea in the performance of any contract or subcontract resulting from this solicitation.

____ (2) Does not anticipate that supplies will be transported by sea in the performance of any contract or subcontract resulting from this solicitation.

(c) Any contract resulting from this solicitation will include the Transportation of Supplies by Sea clause. If the Offeror represents that it will not use ocean transportation, the resulting contract will also include the Defense FAR Supplement clause at 252.247-7024, Notification of Transportation of Supplies by Sea.

(End of provision)

SECTION L Instructions, Conditions and Notices to Bidders

CLAUSES INCORPORATED BY REFERENCE:

52.214-1	Solicitation Definitions--Sealed Bidding	JUL 1987
52.214-3	Amendments To Invitations For Bids	DEC 1989
52.214-4	False Statements In Bids	APR 1984
52.214-5	Submission Of Bids	MAR 1997
52.214-6	Explanation To Prospective Bidders	APR 1984
52.214-7	Late Submissions, Modifications, and Withdrawals of Bids	NOV 1999
52.214-18	Preparation of Bids-Construction	APR 1984
52.214-19	Contract Award-Sealed Bidding-Construction	AUG 1996
52.219-4	Notice of Price Evaluation Preference for HUBZone Small Business Concerns	JAN 1999

CLAUSES INCORPORATED BY FULL TEXT

52.204-6 DATA UNIVERSAL NUMBERING SYSTEM (DUNS) NUMBER (JUN 99)

(a) Contractor identification is essential for complying with statutory contract reporting requirements. Therefore, the offeror is requested to enter, in the block with its name and address on the Standard Form 33 or similar document, the annotation "DUNS" followed by the DUNS number which identifies the offeror's name and address exactly as stated in the offer.

(b) If the offeror does not have a DUNS number, it should contact Dun and Bradstreet directly to obtain one. A DUNS number will be provided immediately by telephone at no charge to the offeror. For information on obtaining a DUNS number, the offeror, if located within the United States, should call Dun and Bradstreet at 1-800-333-0505. The offeror should be prepared to provide the following information:

- (1) Company name.
- (2) Company address.
- (3) Company telephone number.
- (4) Line of business.
- (5) Chief executive officer/key manager.
- (6) Date the company was started.
- (7) Number of people employed by the company.
- (8) Company affiliation.

(c) Offerors located outside the United States may obtain the location and phone number of the local Dun and Bradstreet Information Services office from the Internet Home Page at <http://www.customerservice@dnb.com/>. If an offeror is unable to locate a local service center, it may send an e-mail to Dun and Bradstreet at globalinfo@dnb.com.

(End of provision)

52.216-1 TYPE OF CONTRACT (APR 1984)

The Government contemplates award of a firm fixed price contract resulting from this solicitation.

(End of clause)

52.222-23 NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION TO ENSURE EQUAL EMPLOYMENT OPPORTUNITY FOR CONSTRUCTION (FEB 1999)

(a) The offeror's attention is called to the Equal Opportunity clause and the Affirmative Action Compliance Requirements for Construction clause of this solicitation.

(b) The goals for minority and female participation, expressed in percentage terms for the Contractor's aggregate workforce in each trade on all construction work in the covered area, are as follows:

Goals for minority participation for each trade	Goals for female participation for each trade
30.6%	6.9%

These goals are applicable to all the Contractor's construction work performed in the covered area. If the Contractor performs construction work in a geographical area located outside of the covered area, the Contractor shall apply the goals established for the geographical area where the work is actually performed. Goals are published periodically in the Federal Register in notice form, and these notices may be obtained from any Office of Federal Contract Compliance Programs office.

(c) The Contractor's compliance with Executive Order 11246, as amended, and the regulations in 41 CFR 60-4 shall be based on (1) its implementation of the Equal Opportunity clause, (2) specific affirmative action obligations required by the clause entitled "Affirmative Action Compliance Requirements for Construction," and (3) its efforts to meet the goals. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade. The Contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from Contractor to Contractor, or from project to project, for the sole purpose of meeting the Contractor's goals shall be a violation of the contract, Executive Order 11246, as amended, and the regulations in 41 CFR 60-4. Compliance with the goals will be measured against the total work hours performed.

(d) The Contractor shall provide written notification to the Deputy Assistant Secretary for Federal Contract Compliance, U.S. Department of Labor, within 10 working days following award of any construction subcontract in excess of \$10,000 at any tier for construction work under the contract resulting from this solicitation. The notification shall list the --

- (1) Name, address, and telephone number of the subcontractor;
- (2) Employer's identification number of the subcontractor;
- (3) Estimated dollar amount of the subcontract;
- (4) Estimated starting and completion dates of the subcontract; and
- (5) Geographical area in which the subcontract is to be performed.

- (e) As used in this Notice, and in any contract resulting from this solicitation, the "covered area" is Chatham/Hunter Army Airfield/Georgia

52.233-2 SERVICE OF PROTEST (AUG 1996)

- (a) Protests, as defined in section 33.101 of the Federal Acquisition Regulation, that are filed directly with an agency, and copies of any protests that are filed with the General Accounting Office (GAO), shall be served on the Contracting Officer (addressed as follows) by obtaining written and dated acknowledgment of receipt from

Directorate of Contracting
1042 William H. Wilson Ave. St 209
Fort Stewart, Georgia 31314

- (b) The copy of any protest shall be received in the office designated above within one day of filing a protest with the GAO.

- (c) In this procurement, you may not protest to the GSBCA because of the nature of the supplies or services being procured. (Contracting Officer shall strike the word "not" where the GSBCA is a correct forum.)

52.236-27 SITE VISIT (CONSTRUCTION) (FEB 1995) – ALTERNATE I (FEB 1995)

- (a) The clauses at 52.236-2, Differing Site Conditions, and 52.236-3, Site Investigations and Conditions Affecting the Work, will be included in any contract awarded as a result of this solicitation. Accordingly, offerors or quoters are urged and expected to inspect the site where the work will be performed.

- (b) An organized site visit has been scheduled for—

22 Aug 2001 @ 10:00 a.m.

- (c) Participants will meet at—Building 1021 Hunter Army Airfield, Georgia
(912) 353-2366

252.204-7001 COMMERCIAL AND GOVERNMENT ENTITY (CAGE) CODE REPORTING (AUG 1999)

- (a) The offeror is requested to enter its CAGE code on its offer in the block with its name and address. The CAGE code entered must be for that name and address. Enter "CAGE" before the number.

- (b) If the offeror does not have a CAGE code, it may ask the Contracting Officer to request one from the Defense Logistics Information Service (DLIS). The Contracting Officer will--

- (1) Ask the Contractor to complete section B of a DD Form 2051, Request for Assignment of a Commercial and Government Entity (CAGE) Code;

- (2) Complete section A and forward the form to DLIS; and

- (3) Notify the Contractor of its assigned CAGE code.

- (c) Do not delay submission of the offer pending receipt of a CAGE code.

(End of provision)

252.204-7004 REQUIRED CENTRAL CONTRACTOR REGISTRATION.(MAR 2000)

(a) Definitions.

As used in this clause--

(1) Central Contractor Registration (CCR) database means the primary DoD repository for contractor information required for the conduct of business with DoD.

(2) Data Universal Numbering System (DUNS) number means the 9-digit number assigned by Dun and Bradstreet Information Services to identify unique business entities.

(3) Data Universal Numbering System +4 (DUNS+4) number means the DUNS number assigned by Dun and Bradstreet plus a 4-digit suffix that may be assigned by a parent (controlling) business concern. This 4-digit suffix may be assigned at the discretion of the parent business concern for such purposes as identifying subunits or affiliates of the parent business concern.

(4) Registered in the CCR database means that all mandatory information, including the DUNS number or the DUNS+4 number, if applicable, and the corresponding Commercial and Government Entity (CAGE) code, is in the CCR database; the DUNS number and the CAGE code have been validated; and all edits have been successfully completed.

(b)(1) By submission of an offer, the offeror acknowledges the requirement that a prospective awardee must be registered in the CCR database prior to award, during performance, and through final payment of any contract resulting from this solicitation, except for awards to foreign vendors for work to be performed outside the United States.

(2) The offeror shall provide its DUNS or, if applicable, its DUNS+4 number with its offer, which will be used by the Contracting Officer to verify that the offeror is registered in the CCR database.

(3) Lack of registration in the CCR database will make an offeror ineligible for award.

(4) DoD has established a goal of registering an applicant in the CCR database within 48 hours after receipt of a complete and accurate application via the Internet. However, registration of an applicant submitting an application through a method other than the Internet may take up to 30 days. Therefore, offerors that are not registered should consider applying for registration immediately upon receipt of this solicitation.

(c) The Contractor is responsible for the accuracy and completeness of the data within the CCR, and for any liability resulting from the Government's reliance on inaccurate or incomplete data. To remain registered in the CCR database after the initial registration, the Contractor is required to confirm on an annual basis that its information in the CCR database is accurate and complete.

(d) Offerors and contractors may obtain information on registration and annual confirmation requirements by calling 1-888-227-2423, or via the Internet at <http://www.ccr2000.com>.

(End of clause)

252.236-7006 COST LIMITATION (JAN 1997)

(a) Certain items in this solicitation are subject to statutory cost limitations. The limitations are stated in the Schedule.

(b) An offer which does not state separate prices for the items identified in the Schedule as subject to a cost limitation may be considered nonresponsive.

(c) Prices stated in offers for items subject to cost limitations shall include an appropriate apportionment of all costs, direct and indirect, overhead, and profit.

(d) Offers may be rejected which--

(1) Are materially unbalanced for the purpose of bringing items within cost limitations; or

(2) Exceed the cost limitations, unless the limitations have been waived by the Government prior to award.

SECTION M Evaluation Factors for Award

CLAUSES INCORPORATED BY FULL TEXT

52.000-4025 REQUIREMENT TO BID/OFFER ON ALL ITEMS

Failure to submit a bid/offer on all items shall result in rejection of the bid.

252.236-7007 ADDITIVE OR DEDUCTIVE ITEMS. (DEC 1991)

(a) The low offeror and the items to be awarded shall be determined as follows --

(1) Prior to the opening of bids, the Government will determine the amount of funds available for the project.

(2) The low offeror shall be the Offeror that --

(i) Is otherwise eligible for award; and

(ii) Offers the lowest aggregate amount for the first or base bid item, plus or minus (in the order stated in the list of priorities in the bid schedule) those additive or deductive items that provide the most features within the funds determined available.

(3) The Contracting Officer shall evaluate all bids on the basis of the same additive or deductive items.

(i) If adding another item from the bid schedule list of priorities would make the award exceed the available funds for all offerors, the Contracting Officer will skip that item and go to the next item from the bid schedule of priorities; and

(ii) Add that next item if an award may be made that includes that item and is within the available funds.

(b) The Contracting Officer will use the list of priorities in the bid schedule only to determine the low offeror. After determining the low offeror, an award may be made on any combination of items if --

(1) It is in the best interest of the Government;

(2) Funds are available at the time of award; and

(3) The low offeror's price for the combination to be awarded is less than the price offered by any other responsive, responsible offeror.

(c) "Example." The amount available is \$100,000. Offeror A's base bid and four additives (in the order stated in the list of priorities in the bid Schedule) are \$85,000, \$10,000, \$8,000, \$6,000, and \$4,000. Offeror B's base bid and four additives are \$80,000, \$16,000, \$9,000, \$7,000, and \$4,000. Offeror A is the low offeror. The aggregate amount of offeror A's bid for purposes of award would be \$99,000, which includes a base bid plus the first and fourth additives. The second and third additives were skipped because each of them would cause the aggregate bid to exceed \$100,000.

52.000-4016a BASIS OF AWARD

Award will be made to the responsible bidder submitting the lowest, responsive bid using the evaluation procedures set forth in FAR Clause 52.219-4 , Notice of Price Evaluation Preference for HUBZone Small Business Concerns and DFAR 252.236-7007, Additive or Deductive Items.